UNION TOOL

Tungsten Carbide End Mills
UNIMAX Series

For Cemented Carbide and Hard Brittle Materials

Vol.11

Diamond Coated 2 Flute UDC Series

UDC

Total 16 Models	**UDCBF**	High-grade Ball End Mills
Add 4 Total 61 Models	**UDCLBF**	High-grade Long Neck Ball End Mills
Add 22 Total 52 Models	**UDCLRSF**	High-grade Long Neck Radius End Mills
Total 14 Models	**UDCB**	Ball End Mills
Total 37 Models	**UDCLB**	Long Neck Ball End Mills
Total 30 Models	**UDCLRS**	Long Neck Radius End Mills
Add 7 Total 35 Models	**UDCMX**	Drills
Total 10 Models	**UDCT**	Thread Mills

UNION TOOL CO.

Features

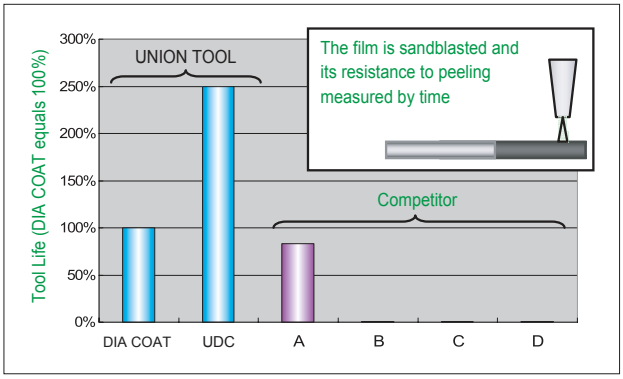
Revolutionary Diamond coating offers excellent cutting performance

1 A Strong and Powerful Diamond Coating - UDC!!

Coating Patented in Japan

Special high-performance Diamond film.
A new Diamond coating developed to improve hardness and durability, with outstanding adhesion to the cutting tool.

Sandblasting tests the film adhesion and wear resistance



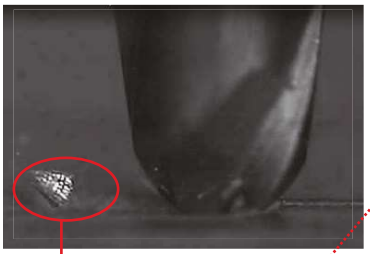
UNION TOOL's Diamond film that coated using the hot filament CVD method is developed to improve hardness and durability, with outstanding adhesion to the cutting tool. Using fine particle composition control, the UDC coating has dramatically improved hardness and durability.

2 Direct Milling of Cemented Carbide - No Grinding!

VM-40 (90HRA)

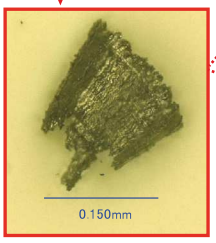
The normal expectation when milling Cemented Carbide would be a powdered swarf….

By using a deep cut into the Cemented Carbide, UDCB creates a “fan shaped” chip, just like cutting steel!



UDCB chip evacuation

(a) Inside view of a curled chip (surface side)



Chip size

“Fan-shaped” chip created

(b) Outside view (tool / rake side)

UDCB R0.5 Ball End Mill

Tool	UDCB 2010-0070（R0.5×0.7）
Spindle Speed	30,000 min^{-1}
Feed Rate	300 mm/min
a_p Axial Depth	0.1 mm
Coolant	Air Blow

“Cutting” Cemented Carbide is achieved using the latest Diamond coating - UDC

EDM and UDCB Direct Milling Comparison

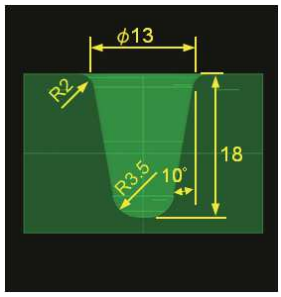
VM-40 (90HRA)

Case Study : Simulation of deep pocket milling with UDCB R3

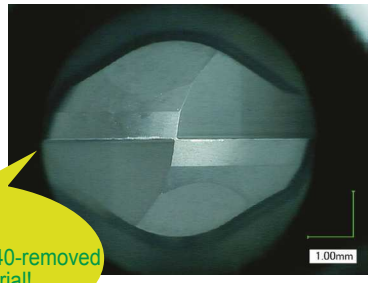
UDCB R3 Ball End Mill
Deep tapered circular pocket milling on Cemented Carbide

Work Sample

Size

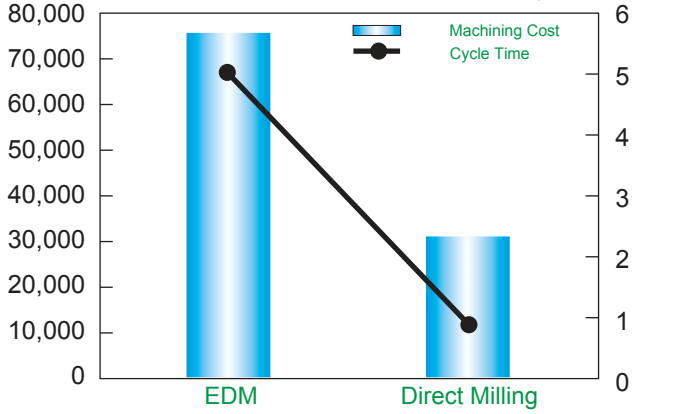


After milling



One tool-Milling VM-40-removed 1.4cc of material!

Machining Cost / Cycle Time (h)



UDCB Advantages

- 80% cycle time reduction
- 60% machining cost reduction
- No substrate damage
  - Reduces polishing time - unlike EDM
- Excellent accuracy of the finished part

EDM

		Qty/h	(¥) Unit Price	(¥) Total	(h) Cycle Time
Making Copper Electrode	Tool	3	3,000	9,000	2
	Material	1	2,000	2,000	
	Machine	2	5,000	10,000	
	Operator	2	8,000	16,000	
EDM	Machine	3	5,000	15,000	3
	Operator	3	8,000	24,000	
Total				76,000	5

Direct Milling

		Qty/h	(¥) Unit Price	(¥) Total	(h) Cycle Time
Milling Carbide	Tool (UDCB)	1	17,500	17,500	1
	Machine	1	5,000	5,000	
	Operator	1	8,000	8,000	
Total				30,500	1

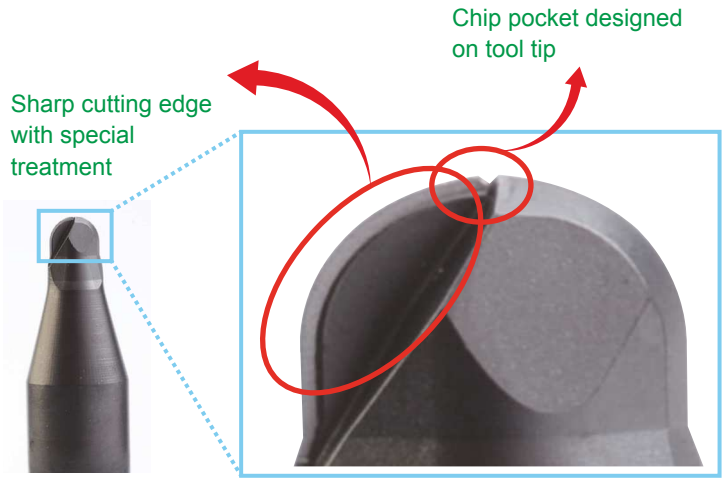
Tool	UDCB 2060-0420 (R3x4.2)
Spindle Speed	20,000 min^{-1}
Feed Rate	200 mm/min
Axial Depth a_p	0.2 mm
Radial Depth a_e	0.4 mm
Coolant	Air Blow
Cycle Time	52 min
Material Removal Volume	1,400 mm^3 (1.4 cc) 26.9 mm^3/min

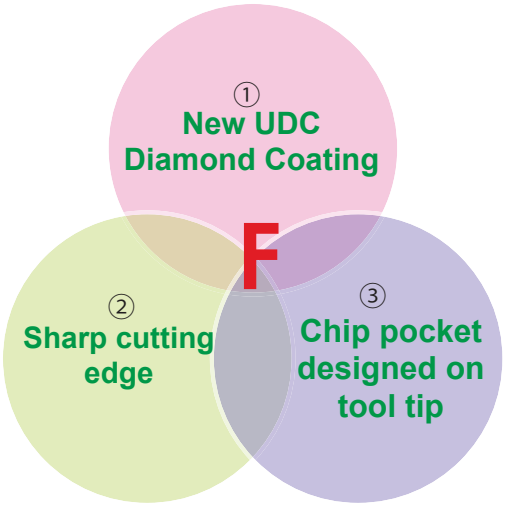
UDCB
Deep Milling Video

"F (Fine)" Series Advantages

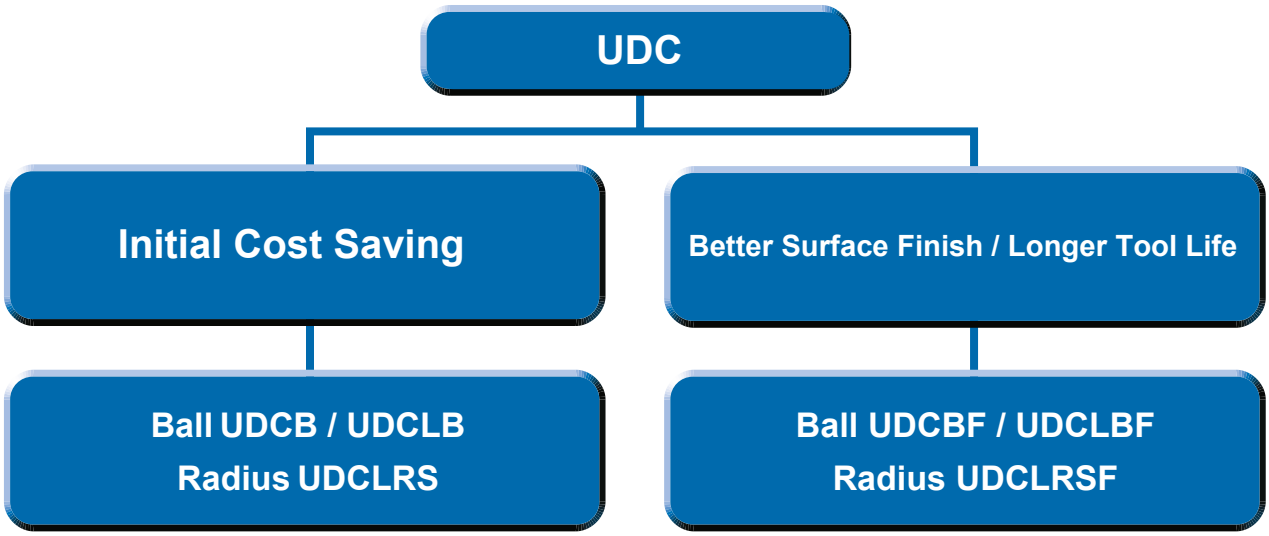
"F (Fine)" Series offers

①Seamless surface finish
②Minimized edge chipping
③More material removal volume

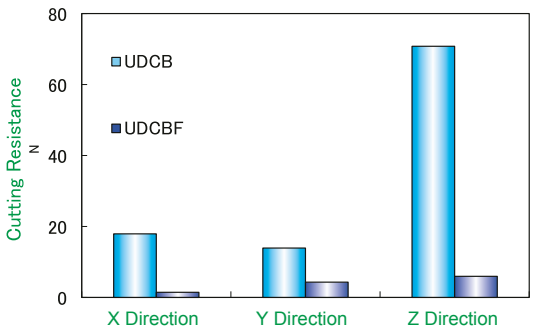




How to Choose



Cemented Carbide Cutting Resistance Comparison using UDCBF R0.5x0.7 Ball End Mill VM-40 (90HRA)



Tool	UDCB 2010-0070 (R0.5×0.7) UDCBF 2010-0070 (R0.5×0.7)
Spindle Speed	30,000 min^{-1}
Feed Rate	300 mm/min
Axial Depth a_p	0.1 mm
Coolant	Air Blow (Nozzle)

Special treatment on cutting edge reduces cutting resistance!

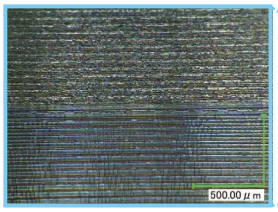
Milling Examples

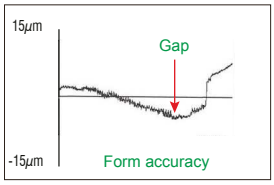
Seamless surface finish

1 Cemented Carbide ϕ20 15° Taper milled with UDCBF R0.5x0.7 Ball End Mill VF-10 (93HRA)

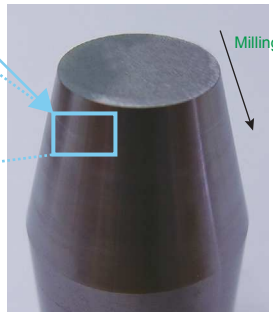
UDCB: Coating damage on cutting edge causes milling gap.
UDCBF: Uniform surface with excellent dimensional accuracy.

Tool	UDCB 2010-0070 (R0.5×0.7) UDCBF 2010-0070 (R0.5×0.7)
Spindle Speed	30,000 min^{-1}
Feed Rate	300 mm/min
Axial Depth a_p	0.05 mm
Radial Depth a_e	0.02 mm
Coolant	Air Blow (Nozzle)
Cycle Time	55 min 5 sec

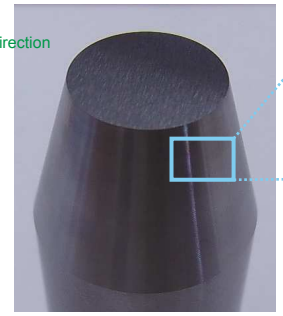




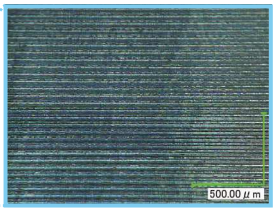
Milling direction

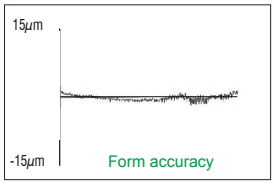


UDCB



UDCBF

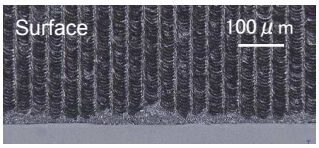


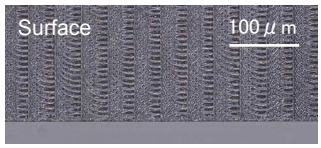


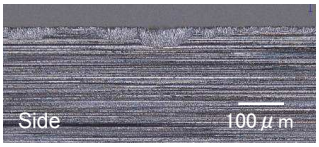
Minimized edge chipping

2 Cemented Carbide Comparison of Edge Chipping using UDCBF R0.5x0.7 Ball End Mill VM-40 (90HRA)

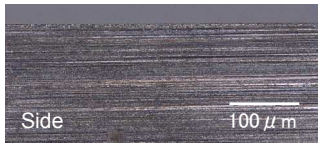
Edge chipping on work material







UDCB

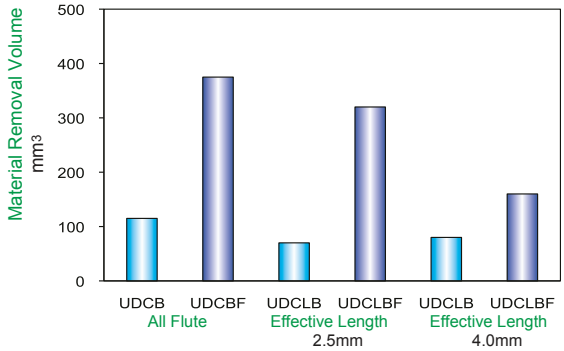


UDCBF

Tool	UDCB 2010-0070 (R0.5×0.7) UDCBF 2010-0070 (R0.5×0.7)
Spindle Speed	30,000 min^{-1}
Feed Rate	300 mm/min
Axial Depth a_p	0.02 mm
Radial Depth a_e	0.05 mm
Coolant	Air Blow (Nozzle)

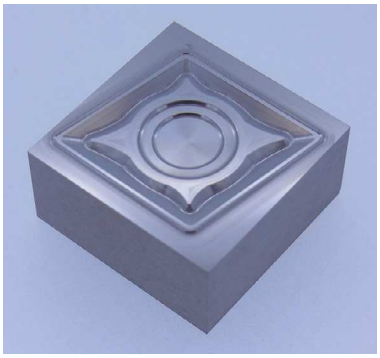
More material removal volume

3 Cemented Carbide Material Removal Volume Comparison on Roughing using UDCBF & UDCLBF VM-40 (90HRA)



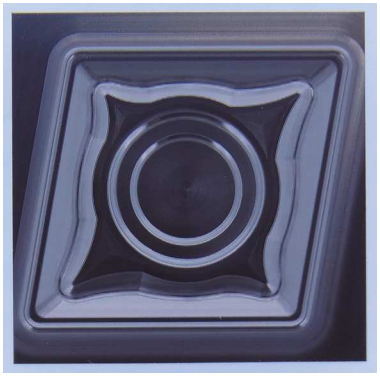
Tool	UDCB 2010-0070 (R0.5×0.7) UDCBF 2010-0070 (R0.5×0.7) UDCLB 2010-0250 (R0.5×2.5×0.7) UDCLBF 2010-0250 (R0.5×2.5×0.7) UDCLB 2010-0400 (R0.5×4×0.7) UDCLBF 2010-0400 (R0.5×4×0.7)
Spindle Speed	30,000 min^{-1}
Feed Rate	300 mm/min
Axial Depth a_p	0.05 mm
Radial Depth a_e	0.25 mm
Coolant	Air Blow (Nozzle)

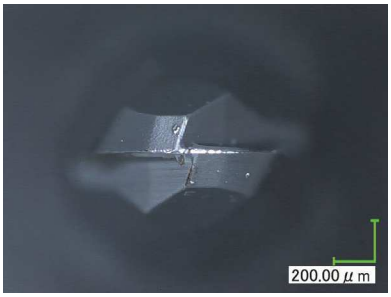
4 Cemented Carbide Indexable Insert Mold milled with UDCBF R0.5x0.7 Ball End Mill VM-40 (90HRA)



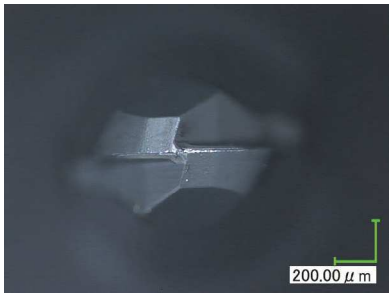
	Roughing	Finishing
Tool	UDCBF 2010-0070（R0.5×0.7）	
Spindle Speed	30,000 min^{-1}	
Feed Rate	300 mm/min	
Axial Depth a_p	0.05 mm	0.028 mm
Radial Depth a_e	0.25 mm	0.02 mm
Coolant	Air Blow (Nozzle)	
Cycle Time	43 min	2 h 17 min
Material Removal Volume	86.3 mm^3	12.0 mm^3

※ One End Mill for both roughing and finishing processes. Total 2 tools are used.





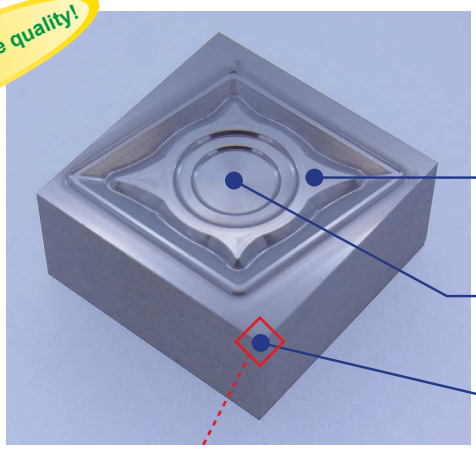
Tool after roughing



Tool after finishing

■ Surface Roughness

Excellent surface quality!



Ra: 0.051 μm
Rz: 0.399 μm

Ra: 0.068 μm
Rz: 0.520 μm

Ra: 0.054 μm
Rz: 0.408 μm

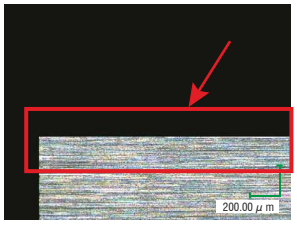
Size：20 × 20 × 10 mm

Minimized edge chipping

Work sample after finishing

Surface

Side



UDCBF Series
Indexable Insert Mold
Milling Video

Available with 3axis machine !

5 Bevel Gear on Cemented Carbide of VU-70(83HRA) milled with UDCLB / UDCLBF R1・R1.5・R2 VU-70 (83HRA)

The number of tool used for processing was 16 pieces, and the processing completed in 15 hours.

Coolant : Air blow

Size ϕ44 × 12.75 mm

CAD/CAM : CAM-TOOL
UDCLB / UDCLBF
Direct milling for Cemented Carbide
Milling Video of Bevel Gear

Milling Process

Process	Tool	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Finishing Allowance (mm)	Quantity	Cycle Time
Roughing	UDCLB 2040-0800 (R2 × 8)	8,250	300	0.5	0.2	0.03	3	2:12:31
	UDCLB 2040-1000 (R2 × 10)	8,250	300	0.5	0.2	0.03	2	0:29:24
Roughing	UDCLB 2030-0600 (R1.5 × 6)	11,000	280	0.38	0.15	0.03	1	0:22:33
	UDCLB 2030-1000 (R1.5 × 10)	11,000	280	0.3	0.15	0.03	1	0:23:27
Semi-finishing	UDCLB 2030-1000 (R1.5 × 10)	11,000	280	(0.005)	-	0.015	1	1:08:35
	UDCLB 2030-1000 (R1.5 × 10)	11,000	280	(0.002)	-	0.005	1	1:36:52
Corner finishing	UDCLB 2020-0600 (R1 × 6)	16,500	420	0.12	0.05	0.015	1	0:52:28
	UDCLB 2020-0800 (R1 × 8)	16,500	420	0.12	0.05	0.015	1	0:49:56
	UDCLB 2020-0800 (R1 × 8)	16,500	420	0.09	-	0.005	1	1:09:32
Finishing	UDCLBF 2020-0800 (R1 × 8)	20,000	200	-	0.12	0	1	0:41:20
	UDCLBF 2020-0800 (R1 × 8)	20,000	200	(0.001)	-	0	2	3:39:54
	UDCLBF 2020-0800 (R1 × 8)	20,000	200	0.09	-	0	1	0:34:00
	UDCLBF 2020-0800 (R1 × 8)	20,000	200	-	0.08	0		1:04:00
						Total	16	15:04:32

6 Binderless Cemented Carbide (90HRA~) Lens Array milled with UDCB R0.5 & R1 Ball End Mills

5 axis machining provides high quality curved surface.

Actual cycle time : 8 h 49 min

Coolant : Air blow

Size : 25 × 25 mm

Milling Process

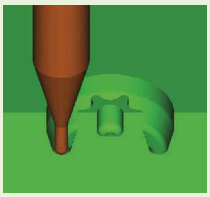
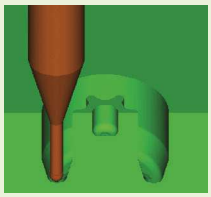
Process	Tool	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
Z-Level High Efficiency Roughing	UDCB 2020-0140 (R1 × 1.4)	30,000	300	0.1	0.3
Z-Level Re-machining	UDCB 2010-0070 (R0.5 × 0.7)	30,000	300	0.05	0.2
Curve Control Along Surface	UDCB 2010-0070 (R0.5 × 0.7)	30,000	300	-	0.02
Z-Level Finishing	UDCB 2010-0070 (R0.5 × 0.7)	30,000	300	-	
Z-Level Finishing	UDCB 2010-0070 (R0.5 × 0.7)	30,000	300	-	

Lens Array
Milling Video

Super durable deep milling!

7 Cemented Carbide Hexalobular milled with UDCLB R0.5x5 & R0.5x2 Long Neck Ball End Mills

VF-20 (92.5HRA)

Milling Conditions	Process 1	Process 2	Process 3
	Roughing Max 3.5 mm depth	Roughing Max 6 mm depth	Finishing
			 ※After finishing process
Tool	UDCLB 2010-0200	UDCLB 2010-0500	
Spindle Speed	30,000 min^{-1}		
Feed Rate	300 mm/min		
Axial Depth a_p	0.05 mm		0.03 mm
Radial Depth a_e	0.3 mm	0.25 mm	0.005 mm
Coolant	Air Blow		
Cycle Time	58 min	64 min	34 min
Material Removal Volume	152.8 mm^3	120 mm^3	1.6 mm^3

R0.5 ball End Mill reaches deep into the pocket (6 mm) with a great depth of cut.

Hexalobular Milling Video

Size: ϕ9, 6 mm depth

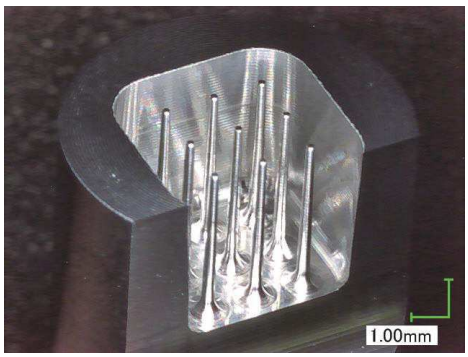
Total : 156 min

Total : 274.4 mm^3

Diameter 0.2 mm ! Carbide micro pin.

8 Cemented Carbide Micro Needles milled with UDCLB R0.5x5 Long Neck Ball End Mill

VF-20 (92.5HRA)



Overall size : 6 x 6 x 5 mm depth

Pin size : Tip diameter: 0.2 mm Pin length: 5 mm

Root diameter: 0.34 mm

	① Max 2.5 mm depth	② Max 5.0 mm depth
Tool	UDCLB 2010-0500（R0.5×5 mm）	
Spindle Speed	30,000 min^{-1}	
Feed Rate	300 mm/min	
Axial Depth a_p	0.1 mm	
Radial Depth a_e	0.05 mm	0.05 mm （Bottom 0.02 mm）
Coolant	Air Blow	
Cycle Time	52 min	39 min
Material Removal Volume	80.1 mm^3	76.5 mm^3

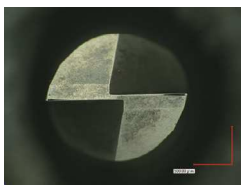
One tool for ① and ②. Total 2 tools are used.

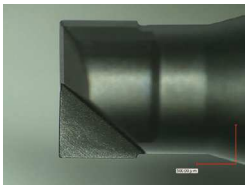
Mirror surface finish with zero pits!

9 Cemented Carbide UDCLRS φ2xCR0.05x2 Long Neck Radius End Mill VM-40 (90HRA)

Side Milling Video

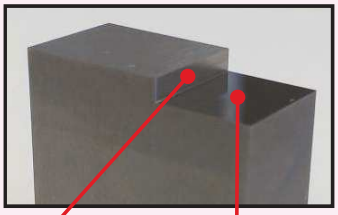
After Finishing





Bottom Surface Appearance

Work sample after finishing



Ra: 0.010 μm
Rz: 0.078 μm
Cut-off length : 0.08 mm

Ra: 0.069 μm
Rz: 0.535 μm
Cut-off length : 0.25 mm

Milling Conditions	Roughing	Finishing
Tool	UDCLRS 2020-005-020	
Spindle Speed	20,000 min^{-1}	20,000 min^{-1}
Feed Rate	750 mm/min	100 mm/min
a_p Axial Depth	0.9 mm	0.01 mm Bottom Surface 0.9 mm Side
a_e Radial Depth	0.01 mm	0.01 mm
Coolant	Air Blow	Oil Mist
Milling Size	10 x 8 x 1.8 mm	0.01 mm Bottom Surface 0.05 mm Side (0.01 mm×5 Times)
Milling Distance	16 m	–
Material Removal Volume	144 mm^3	–

※ One End Mill for both roughing and finishing processes. Total 2 tools are used.

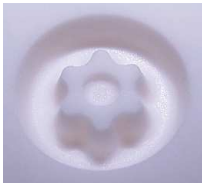
Overhang : 15 mm

Versatile coating ! *

10 Alumina / Zirconia Hexalobular milled with UDCB R0.5x0.7 Ball End Mill

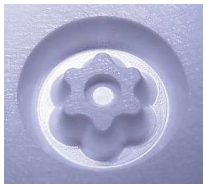
*Designed for the materials stated in the application chart of each series.

Hexalobular



Al_2O_3
Alumina

Size : φ9 x 2.2 mm depth



ZrO_2
Zirconia

Tool	UDCB 2010-0070 (R0.5 × 0.7)
Work Material	Al_2O_3 Alumina / ZrO_2 Zirconia
Spindle Speed	30,000 min^{-1}
Feed Rate	300 mm/min
Axial Depth a_p	0.05 mm
Radial Depth a_e	0.05 mm
Coolant	Air Blow (Nozzle)
Cycle Time	98 min
Material Removal Volume	88.4 mm^3 0.9 mm^3/min

Size **R0.1～R3**

UDCBF

MG UDC 0° R ±0.01 Shank Dia 0/-0.005

Patented in Japan

Material Applications （☆ Highly Recommended ◎ Recommended ○ Suggested）

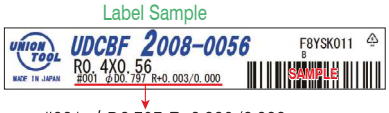
Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○			☆	◎ *

* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

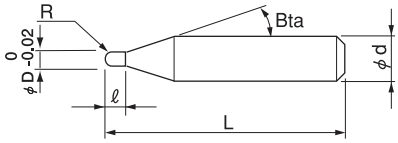
Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Upgraded version of UDCB.
New Diamond coating and tool geometry increase material removal volume.
Chip pocket designed on tool tip improves the surface finishing quality.
Special cutting edge treatment helps to avoid the edge chipping & level gap.
Recommended to use on semi-roughing & finishing process.

Label Sample



#001 φD0.797 R+0.003/0.000

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 16 models

Unit （mm）

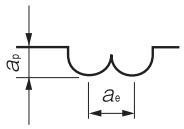
Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥
UDCBF 2002-0014	R0.1	0.14	16°	50	4	47,000
UDCBF 2003-0021	R0.15	0.21	16°	50	4	47,000
UDCBF 2004-0028	R0.2	0.28	16°	50	4	42,800
UDCBF 2005-0035	R0.25	0.35	16°	50	4	42,800
UDCBF 2006-0042	R0.3	0.42	16°	50	4	38,400
UDCBF 2007-0049	R0.35	0.49	16°	50	4	38,400
UDCBF 2008-0056	R0.4	0.56	16°	50	4	38,400
UDCBF 2009-0063	R0.45	0.63	16°	50	4	38,400
UDCBF 2010-0070	R0.5	0.7	16°	50	4	38,400
UDCBF 2012-0084	R0.6	0.84	16°	50	4	38,400
UDCBF 2015-0105	R0.75	1.05	16°	50	4	38,400
UDCBF 2020-0140	R1	1.4	16°	50	4	38,400
UDCBF 2030-0210	R1.5	2.1	16°	60	6	42,300
UDCBF 2040-0280	R2	2.8	16°	60	6	42,300
UDCBF 2050-0350	R2.5	3.5	16°	60	6	42,300
UDCBF 2060-0420	R3	4.2	⊠	60	6	42,300

UDCBF Milling Conditions

WORK MATERIAL			CEMENTED CARBIDE（≧87HRA）/ HARD BRITTLE MATERIALS					CEMENTED CARBIDE（＜87HRA）				
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
2002-0014	**R0.1**	0.14	30,000	100	10	0.01	0.01	30,000	100	10	0.01	0.01
2003-0021	**R0.15**	0.21	30,000	125	13	0.015	0.03	30,000	125	13	0.015	0.03
2004-0028	**R0.2**	0.28	30,000	150	15	0.02	0.08	30,000	150	15	0.02	0.08
2005-0035	**R0.25**	0.35	30,000	175	18	0.025	0.11	30,000	175	18	0.025	0.11
2006-0042	**R0.3**	0.42	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14
2007-0049	**R0.35**	0.49	30,000	225	23	0.035	0.17	30,000	225	23	0.035	0.17
2008-0056	**R0.4**	0.56	30,000	250	25	0.04	0.19	30,000	250	25	0.04	0.19
2009-0063	**R0.45**	0.63	30,000	275	28	0.045	0.22	30,000	275	28	0.045	0.22
2010-0070	**R0.5**	0.7	30,000	300	30	0.05	0.25	30,000	300	150	0.35	0.075
2012-0084	**R0.6**	0.84	27,500	275	36	0.06	0.26	25,000	250	125	0.42	0.09
2015-0105	**R0.75**	1.05	25,000	250	45	0.075	0.27	19,000	190	95	0.525	0.12
2020-0140	**R1**	1.4	20,000	200	60	0.1	0.3	12,500	125	60	0.7	0.15
2030-0210	**R1.5**	2.1	20,000	200	100	0.15	0.3	9,000	280	140	0.38	0.15
2040-0280	**R2**	2.8	18,000	180	90	0.175	0.32	7,200	280	140	0.5	0.2
2050-0350	**R2.5**	3.5	16,000	160	80	0.225	0.31	6,000	330	170	0.6	0.25
2060-0420	**R3**	4.2	15,000	150	75	0.3	0.3	5,500	280	140	0.65	0.28

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (CIS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.
Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.
For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

* Feed Rate2: Feed Rate of Approach and *Connection links.
*Changing from one engagement point to the next.



a_p : Axial Depth（mm）
a_e : Radial Depth（mm）

Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Size **R0.1～R3**

UDCLBF

MG UDC 0° R ±0.01 Shank Dia 0/-0.005

Additional 4 Models | Patented in Japan

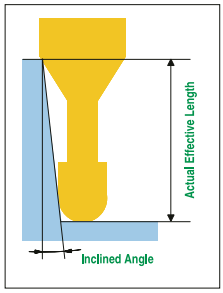
Material Applications （☆ Highly Recommended ◎ Recommended ○ Suggested）

Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○			☆	◎ *

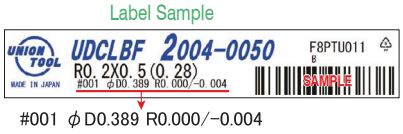
* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

Long Neck Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Upgraded version of UDCLB.
New Diamond coating and tool geometry increase material removal volume.
Chip pocket designed on tool tip improves the surface finishing quality.
Special cutting edge treatment helps to avoid the edge chipping & level gap.
Recommended to use on semi-roughing & finishing process.

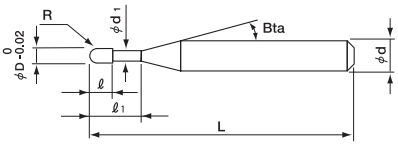


Label Sample



#001 φ D0.389 R0.000/−0.004

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 61 models

Unit （mm）

	Model Number	Radius of Ball Nose R	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°
	UDCLBF 2002-0030	R0.1	0.3	0.14	0.18	16°	50	4	47,500	0.30	0.31	0.32	0.32	0.34
	UDCLBF 2002-0050		0.5				50	4	47,500	0.51	0.52	0.54	0.55	0.59
	UDCLBF 2002-0075		0.75				50	4	47,500	0.77	0.79	0.81	0.84	0.89
	UDCLBF 2002-0100		1				50	4	47,500	1.02	1.05	1.09	1.12	1.20
*	UDCLBF 2003-0050	R0.15	0.5	0.21	0.28	16°	50	4	47,500	0.51	0.52	0.53	0.55	0.58
*	UDCLBF 2003-0075		0.75				50	4	47,500	0.76	0.78	0.81	0.83	0.88
*	UDCLBF 2003-0100		1				50	4	47,500	1.02	1.05	1.08	1.11	1.19
	UDCLBF 2004-0050	R0.2	0.5	0.28	0.36	16°	50	4	43,300	0.54	0.55	0.56	0.58	0.61
	UDCLBF 2004-0100		1				50	4	43,300	1.06	1.08	1.12	1.15	1.22
	UDCLBF 2004-0150		1.5				50	4	43,300	1.57	1.62	1.67	1.72	1.83
	UDCLBF 2004-0200		2				50	4	43,300	2.09	2.15	2.22	2.29	2.44
*	UDCLBF 2004-0250		2.5				50	4	43,300	2.60	2.68	2.77	2.86	3.06
	UDCLBF 2006-0100	R0.3	1	0.42	0.56	16°	50	4	38,900	1.05	1.08	1.11	1.13	1.20
	UDCLBF 2006-0150		1.5				50	4	38,900	1.57	1.61	1.66	1.70	1.81
	UDCLBF 2006-0200		2				50	4	38,900	2.08	2.14	2.21	2.27	2.42
	UDCLBF 2006-0300		3				50	4	38,900	3.12	3.21	3.31	3.41	3.65
	UDCLBF 2006-0400		4				50	4	38,900	4.15	4.27	4.41	4.55	4.87
	UDCLBF 2006-0500		5				50	4	38,900	5.18	5.34	5.51	5.69	6.09
	UDCLBF 2006-0600		6				50	4	38,900	6.21	6.40	6.61	6.83	7.32

* Additional model

2 Flutes High-grade Long Neck Ball End Mills for Cemented Carbide and Hard Brittle Materials

Model Number	Radius of Ball Nose R	Effective Length ℓ_1	Length of Cut ℓ	Neck Diameter $Ød_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°
UDCLBF 2008-0200	R0.4	2	0.56	0.76	16°	50	4	38,900	2.08	2.14	2.20	2.26	2.40
UDCLBF 2008-0300		3				50	4	38,900	3.11	3.20	3.30	3.40	3.62
UDCLBF 2008-0400		4				50	4	38,900	4.14	4.27	4.40	4.54	4.85
UDCLBF 2008-0500		5				50	4	38,900	5.18	5.33	5.50	5.67	6.07
UDCLBF 2008-0600		6				50	4	38,900	6.21	6.40	6.60	6.81	7.29
UDCLBF 2008-0800		8				50	4	38,900	8.27	8.53	8.80	9.09	9.74
UDCLBF 2010-0150	R0.5	1.5	0.7	0.96	16°	50	4	38,900	1.56	1.60	1.64	1.68	1.77
UDCLBF 2010-0200		2				50	4	38,900	2.08	2.13	2.19	2.25	2.38
UDCLBF 2010-0250		2.5				50	4	38,900	2.59	2.66	2.74	2.81	2.99
UDCLBF 2010-0300		3				50	4	38,900	3.11	3.20	3.29	3.38	3.60
UDCLBF 2010-0400		4				50	4	38,900	4.14	4.26	4.39	4.52	4.83
UDCLBF 2010-0600		6				50	4	38,900	6.20	6.39	6.59	6.80	7.27
UDCLBF 2010-0800		8				50	4	38,900	8.27	8.52	8.79	9.08	9.72
UDCLBF 2010-1000		10				50	4	38,900	10.33	10.65	10.99	11.35	12.17
UDCLBF 2015-0200	R0.75	2	1.05	1.4	16°	50	4	38,900	2.11	2.15	2.20	2.25	2.37
UDCLBF 2015-0400		4				50	4	38,900	4.17	4.28	4.40	4.53	4.81
UDCLBF 2015-0600		6				50	4	38,900	6.23	6.41	6.60	6.81	7.26
UDCLBF 2015-0800		8				50	4	38,900	8.29	8.54	8.80	9.08	9.71
UDCLBF 2015-1000		10				50	4	38,900	10.36	10.67	11.00	11.36	12.16
UDCLBF 2015-1200		12				50	4	38,900	12.42	12.80	13.20	13.64	14.60
UDCLBF 2020-0300	R1	3	1.4	1.9	16°	50	4	38,900	3.20	3.27	3.35	3.43	3.62
UDCLBF 2020-0400		4				50	4	38,900	4.23	4.34	4.45	4.57	4.84
UDCLBF 2020-0600		6				50	4	38,900	6.30	6.47	6.65	6.85	7.29
UDCLBF 2020-0800		8				50	4	38,900	8.36	8.60	8.85	9.13	9.74
UDCLBF 2020-1000		10				50	4	38,900	10.42	10.73	11.06	11.41	12.19
UDCLBF 2020-1200		12				50	4	38,900	12.48	12.86	13.26	13.68	14.63
UDCLBF 2020-1400		14				50	4	38,900	14.55	14.99	15.46	15.96	17.08
UDCLBF 2020-1600		16				50	4	38,900	16.61	17.12	17.66	18.24	19.53
UDCLBF 2020-1800		18				60	4	38,900	18.67	19.25	19.86	20.52	No Interference
UDCLBF 2020-2000		20				60	4	38,900	20.74	21.38	22.06	22.79	No Interference
UDCLBF 2030-0600	R1.5	6	2.1	2.9	16°	60	6	42,800	6.28	6.44	6.60	6.78	7.18
UDCLBF 2030-0800		8				60	6	42,800	8.34	8.57	8.80	9.06	9.63
UDCLBF 2030-1000		10				60	6	42,800	10.41	10.70	11.01	11.34	12.08
UDCLBF 2030-1200		12				60	6	42,800	12.47	12.83	13.21	13.61	14.52
UDCLBF 2030-1400		14				60	6	42,800	14.53	14.96	15.41	15.89	16.97
UDCLBF 2040-0800	R2	8	2.8	3.9	16°	60	6	42,800	8.33	8.53	8.76	8.99	9.52
UDCLBF 2040-1000		10				60	6	42,800	10.39	10.66	10.96	11.27	11.97
UDCLBF 2040-1500		15				60	6	42,800	15.55	15.99	16.46	16.96	18.09
UDCLBF 2050-1000	R2.5	10	3.5	4.8	16°	60	6	42,800	10.55	10.82	11.10	11.40	12.07
UDCLBF 2050-1500		15				60	6	42,800	15.71	16.14	16.60	17.09	No Interference
UDCLBF 2060-1000	R3	10	4.2	5.7	□	60	6	42,800	No Interference	No Interference	No Interference	No Interference	No Interference
UDCLBF 2060-1500		15				60	6	42,800	No Interference	No Interference	No Interference	No Interference	No Interference

UDCLBF Milling Conditions

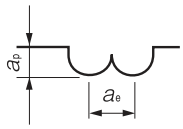
WORK MATERIAL			CEMENTED CARBIDE(≧87HRA) / HARD BRITTLE MATERIALS					CEMENTED CARBIDE(<87HRA)				
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
2002-0030	**R0.1**	0.3	30,000	100	10	0.01	0.01	30,000	100	10	0.01	0.01
2002-0050		0.5	30,000	30	10	0.005	0.008	30,000	30	10	0.005	0.008
2002-0075		0.75	30,000	30	10	0.005	0.006	30,000	30	10	0.005	0.006
2002-0100		1	30,000	25	10	0.005	0.005	30,000	25	10	0.005	0.005
2003-0050	**R0.15**	0.5	30,000	100	10	0.01	0.03	30,000	100	10	0.01	0.03
2003-0075		0.75	30,000	80	10	0.01	0.02	30,000	80	10	0.01	0.02
2003-0100		1	30,000	60	10	0.01	0.02	30,000	60	10	0.01	0.02
2004-0050	**R0.2**	0.5	30,000	150	15	0.02	0.08	30,000	150	15	0.02	0.08
2004-0100		1	30,000	100	10	0.015	0.07	30,000	100	10	0.015	0.07
2004-0150		1.5	30,000	60	10	0.01	0.06	30,000	60	10	0.01	0.06
2004-0200		2	30,000	30	10	0.008	0.05	30,000	30	10	0.008	0.05
2004-0250		2.5	30,000	15	10	0.006	0.03	30,000	15	10	0.006	0.03
2006-0100	**R0.3**	1	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14
2006-0150		1.5	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14
2006-0200		2	30,000	150	15	0.022	0.11	30,000	150	15	0.022	0.11
2006-0300		3	30,000	75	10	0.01	0.08	30,000	75	10	0.01	0.08
2006-0400		4	30,000	75	10	0.01	0.08	30,000	75	10	0.01	0.08
2006-0500		5	30,000	75	10	0.01	0.06	30,000	75	10	0.01	0.06
2006-0600		6	30,000	75	10	0.01	0.03	30,000	75	10	0.01	0.03
2008-0200	**R0.4**	2	30,000	250	25	0.04	0.19	30,000	250	25	0.04	0.19
2008-0300		3	30,000	230	23	0.037	0.17	30,000	230	23	0.037	0.17
2008-0400		4	30,000	210	21	0.035	0.16	30,000	210	21	0.035	0.16
2008-0500		5	25,000	170	20	0.03	0.12	25,000	170	20	0.03	0.12
2008-0600		6	20,000	130	20	0.025	0.08	20,000	130	20	0.025	0.08
2008-0800		8	15,000	100	20	0.015	0.03	15,000	100	20	0.015	0.03
2010-0150	**R0.5**	1.5	30,000	300	30	0.05	0.25	30,000	300	150	0.35	0.075
2010-0200		2	30,000	300	30	0.05	0.25	30,000	300	150	0.35	0.075
2010-0250		2.5	30,000	300	30	0.05	0.25	30,000	300	150	0.35	0.075
2010-0300		3	30,000	300	30	0.05	0.25	25,000	250	125	0.35	0.075
2010-0400		4	30,000	300	30	0.05	0.25	25,000	250	125	0.2	0.1
2010-0600		6	25,000	250	25	0.04	0.15	25,000	250	125	0.1	0.1
2010-0800		8	20,000	200	25	0.025	0.07	20,000	200	100	0.03	0.08
2010-1000		10	10,000	100	20	0.018	0.03	20,000	200	100	0.02	0.04
2015-0200	**R0.75**	2	25,000	250	45	0.075	0.27	18,000	180	90	0.52	0.12
2015-0400		4	25,000	250	45	0.075	0.27	18,000	180	90	0.52	0.12
2015-0600		6	25,000	250	45	0.075	0.27	18,000	180	90	0.4	0.12
2015-0800		8	20,000	160	30	0.075	0.27	18,000	180	90	0.2	0.2
2015-1000		10	20,000	130	30	0.05	0.15	18,000	180	90	0.075	0.25
2015-1200		12	16,000	100	30	0.03	0.08	13,500	135	70	0.05	0.16

UDCLBF Milling Conditions

WORK MATERIAL			CEMENTED CARBIDE (≧87HRA) / HARD BRITTLE MATERIALS					CEMENTED CARBIDE (<87HRA)				
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
2020-0300	**R1**	3	20,000	200	60	0.1	0.3	12,500	125	60	0.7	0.15
2020-0400		4	20,000	200	60	0.1	0.3	12,500	125	60	0.7	0.15
2020-0600		6	20,000	200	60	0.1	0.3	12,500	125	60	0.7	0.15
2020-0800		8	20,000	200	60	0.1	0.3	12,500	125	60	0.4	0.2
2020-1000		10	20,000	200	60	0.1	0.3	12,500	125	60	0.25	0.25
2020-1200		12	20,000	200	60	0.09	0.25	12,500	125	60	0.1	0.3
2020-1400		14	20,000	200	60	0.07	0.15	12,500	125	60	0.1	0.3
2020-1600		16	13,000	130	36	0.04	0.08	12,500	125	60	0.1	0.3
2020-1800		18	10,000	100	30	0.025	0.05	10,000	100	50	0.04	0.1
2020-2000		20	10,000	100	30	0.02	0.035	10,000	100	50	0.02	0.07
2030-0600	**R1.5**	6	20,000	200	100	0.15	0.3	9,000	280	140	0.38	0.15
2030-0800		8	20,000	200	100	0.15	0.3	9,000	280	140	0.38	0.15
2030-1000		10	20,000	200	100	0.15	0.3	9,000	280	140	0.38	0.15
2030-1200		12	20,000	200	100	0.15	0.3	9,000	280	140	0.38	0.15
2030-1400		14	20,000	200	100	0.15	0.3	9,000	280	140	0.38	0.15
2040-0800	**R2**	8	18,000	180	90	0.175	0.32	7,200	280	140	0.5	0.2
2040-1000		10	18,000	180	90	0.175	0.32	7,200	280	140	0.5	0.2
2040-1500		15	18,000	180	90	0.175	0.32	7,200	280	140	0.5	0.2
2050-1000	**R2.5**	10	16,000	160	80	0.225	0.31	6,000	330	170	0.6	0.25
2050-1500		15	16,000	160	80	0.225	0.31	6,000	330	170	0.6	0.25
2060-1000	**R3**	10	15,000	150	75	0.3	0.3	5,500	280	140	0.65	0.28
2060-1500		15	15,000	150	75	0.3	0.3	5,500	280	140	0.65	0.28

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (CIS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.
Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.
For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

* Feed Rate2: Feed Rate of Approach and *Connection links.
*Changing from one engagement point to the next.



a_p : Axial Depth (mm)
a_e : Radial Depth (mm)

Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Size φ0.3～φ2

UDCLRSF

MG UDC 0° R R ±0.01 Shank Dia 0/-0.005

Additional 22 Models | Patented in Japan

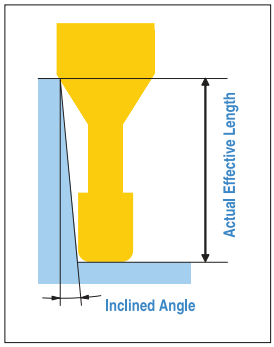
Material Applications （☆ Highly Recommended ◎ Recommended ○ Suggested）

Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○			☆	◎ *

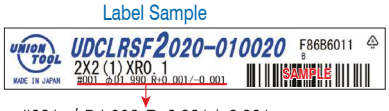
* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

Long Neck Radius End Mills for milling Cemented Carbide & Hard Brittle (Non-Metallic) Materials.
Upgraded version of UDCLRS.
Achieve remarkable cutting depth and longer tool life.
Special cutting edge treatment helps to avoid the edge chipping & level gap on the work piece.
Recommended to use on semi-roughing & finishing process.

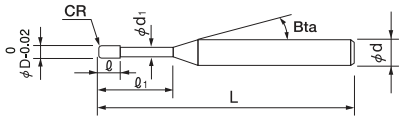


Label Sample



#001 φD1.990 R+0.001/−0.001

Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 52 models

Unit （mm）

	Model Number	Outside Diameter ØD	Coner Radius CR	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°
	UDCLRSF 2003-003006	0.3	R0.03	0.6	0.15	0.28	16°	50	4	54,600	0.61	0.63	0.65	0.67	0.72
	UDCLRSF 2003-005006		R0.05	0.6				50	4	54,600	0.61	0.63	0.65	0.67	0.72
	UDCLRSF 2005-003005	0.5	R0.03	0.5	0.25	0.46	16°	50	4	52,000	0.55	0.56	0.58	0.60	0.64
	UDCLRSF 2005-003010			1				50	4	52,000	1.06	1.10	1.13	1.17	1.25
*	UDCLRSF 2005-003015			1.5				50	4	52,000	1.58	1.63	1.68	1.74	1.87
	UDCLRSF 2005-005005		R0.05	0.5				50	4	52,000	0.55	0.56	0.58	0.60	0.64
	UDCLRSF 2005-005010			1				50	4	52,000	1.06	1.09	1.13	1.17	1.25
*	UDCLRSF 2005-005015			1.5				50	4	52,000	1.58	1.63	1.68	1.74	1.86
	UDCLRSF 2008-003008	0.8	R0.03	0.8	0.4	0.76	16°	50	4	46,700	0.86	0.88	0.91	0.94	1.01
	UDCLRSF 2008-003016			1.6				50	4	46,700	1.68	1.73	1.79	1.85	1.99
*	UDCLRSF 2008-003024			2.4				50	4	46,700	2.51	2.59	2.67	2.76	2.97
	UDCLRSF 2008-005008		R0.05	0.8				50	4	46,700	0.85	0.88	0.91	0.94	1.01
	UDCLRSF 2008-005016			1.6				50	4	46,700	1.68	1.73	1.79	1.85	1.98
*	UDCLRSF 2008-005024			2.4				50	4	46,700	2.50	2.58	2.67	2.76	2.96
	UDCLRSF 2008-010008		R0.1	0.8				50	4	46,700	0.85	0.88	0.90	0.93	0.99
	UDCLRSF 2008-010016			1.6				50	4	46,700	1.68	1.73	1.78	1.84	1.97
*	UDCLRSF 2008-010024			2.4				50	4	46,700	2.50	2.58	2.66	2.75	2.95

* Additional model

2Flutes High-grade Long Neck Radius End Mills for Cemented Carbide and Hard Brittle Materials

	Model Number	Outside Diameter ØD	Coner Radius CR	Effective Length $ℓ_1$	Length of Cut ℓ	Neck Diameter $Ød_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°
	UDCLRSF 2010-003010	1	R0.03	1	0.5	0.96	16°	50	4	46,700	1.06	1.10	1.13	1.17	1.25
	UDCLRSF 2010-003020			2				50	4	46,700	2.09	2.16	2.23	2.31	2.48
*	UDCLRSF 2010-003040			4				50	4	46,700	4.16	4.29	4.43	4.59	4.93
*	UDCLRSF 2010-003060			6				50	4	46,700	6.22	6.42	6.63	6.86	7.37
	UDCLRSF 2010-005010		R0.05	1				50	4	46,700	1.06	1.09	1.13	1.17	1.25
	UDCLRSF 2010-005020			2				50	4	46,700	2.09	2.16	2.23	2.31	2.47
*	UDCLRSF 2010-005040			4				50	4	46,700	4.15	4.29	4.43	4.58	4.92
*	UDCLRSF 2010-005060			6				50	4	46,700	6.22	6.42	6.63	6.86	7.37
	UDCLRSF 2010-010010		R0.1	1				50	4	46,700	1.06	1.09	1.12	1.16	1.24
	UDCLRSF 2010-010020			2				50	4	46,700	2.09	2.16	2.22	2.30	2.46
*	UDCLRSF 2010-010040			4				50	4	46,700	4.15	4.28	4.43	4.58	4.91
*	UDCLRSF 2010-010060			6				50	4	46,700	6.22	6.41	6.63	6.85	7.36
	UDCLRSF 2015-003015	1.5	R0.03	1.5	0.75	1.44	16°	50	4	46,700	1.61	1.66	1.72	1.78	1.91
	UDCLRSF 2015-003030			3				50	4	46,700	3.16	3.26	3.37	3.49	3.74
	UDCLRSF 2015-005015		R0.05	1.5				50	4	46,700	1.61	1.66	1.72	1.78	1.90
	UDCLRSF 2015-005030			3				50	4	46,700	3.16	3.26	3.37	3.48	3.74
	UDCLRSF 2015-010015		R0.1	1.5				50	4	46,700	1.61	1.66	1.71	1.77	1.89
	UDCLRSF 2015-010030			3				50	4	46,700	3.16	3.26	3.36	3.48	3.73
*	UDCLRSF 2015-010040			4				50	4	46,700	4.19	4.32	4.46	4.62	4.95
*	UDCLRSF 2015-010060			6				50	4	46,700	6.25	6.45	6.66	6.89	7.40
	UDCLRSF 2020-003020	2	R0.03	2	1	1.9	16°	50	4	46,700	2.20	2.27	2.35	2.43	2.61
	UDCLRSF 2020-003040			4				50	4	46,700	4.26	4.40	4.55	4.70	5.05
*	UDCLRSF 2020-003060			6				50	4	46,700	6.33	6.53	6.75	6.98	7.50
*	UDCLRSF 2020-003080			8				50	4	46,700	8.39	8.66	8.95	9.26	9.95
*	UDCLRSF 2020-003100			10				50	4	46,700	10.45	10.79	11.15	11.54	12.40
	UDCLRSF 2020-005020		R0.05	2				50	4	46,700	2.20	2.27	2.34	2.42	2.60
	UDCLRSF 2020-005040			4				50	4	46,700	4.26	4.40	4.55	4.70	5.05
*	UDCLRSF 2020-005060			6				50	4	46,700	6.33	6.53	6.75	6.98	7.50
*	UDCLRSF 2020-005080			8				50	4	46,700	8.39	8.66	8.95	9.26	9.94
*	UDCLRSF 2020-005100			10				50	4	46,700	10.45	10.79	11.15	11.53	12.39
	UDCLRSF 2020-010020		R0.1	2				50	4	46,700	2.20	2.27	2.34	2.42	2.59
	UDCLRSF 2020-010040			4				50	4	46,700	4.26	4.40	4.54	4.69	5.04
*	UDCLRSF 2020-010060			6				50	4	46,700	6.32	6.53	6.74	6.97	7.49
*	UDCLRSF 2020-010080			8				50	4	46,700	8.39	8.66	8.94	9.25	9.93
*	UDCLRSF 2020-010100			10				50	4	46,700	10.45	10.79	11.14	11.53	12.38

* Additional model

UDCLRSF Milling Conditions

Refer to page 22 for UDCLRSF note.

WORK MATERIAL	CEMENTED CARBIDE(≧87HRA) / HARD BRITTLE MATERIALS												
Model Number	Spindle Speed (min^{-1})	Z-Level Milling				Flat Milling			Side Milling			Slotting	
		Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)
2003-003006	30,000	220	50	0.015	0.200	220	0.015	0.200	110	0.075	0.006	110	0.015
2003-005006	30,000	220	50	0.020	0.200	220	0.020	0.200	110	0.075	0.006	110	0.020
2005-003005	30,000	190	90	0.020	0.400	190	0.020	0.400	180	0.250	0.010	190	0.020
2005-003010	30,000	190	90	0.020	0.400	190	0.020	0.400	180	0.125	0.010	190	0.020
2005-003015	30,000	140	65	0.015	0.300	140	0.015	0.300	130	0.125	0.007	140	0.015
2005-005005	30,000	190	125	0.020	0.400	190	0.020	0.400	180	0.250	0.010	190	0.020
2005-005010	30,000	190	125	0.020	0.400	190	0.020	0.400	180	0.125	0.010	190	0.020
2005-005015	30,000	140	65	0.015	0.300	140	0.015	0.300	130	0.125	0.007	140	0.015
2008-003008	30,000	190	90	0.020	0.600	190	0.020	0.600	300	0.400	0.016	190	0.020
2008-003016	30,000	190	90	0.020	0.600	190	0.020	0.600	300	0.200	0.010	190	0.020
2008-003024	30,000	175	80	0.018	0.500	175	0.018	0.500	275	0.200	0.007	175	0.018
2008-005008	30,000	190	150	0.025	0.600	190	0.025	0.600	300	0.400	0.016	190	0.025
2008-005016	30,000	190	150	0.025	0.600	190	0.025	0.600	300	0.200	0.010	190	0.025
2008-005024	30,000	175	80	0.023	0.500	175	0.023	0.500	275	0.200	0.007	175	0.023
2008-010008	30,000	190	150	0.030	0.600	190	0.030	0.600	300	0.400	0.016	190	0.030
2008-010016	30,000	190	150	0.030	0.600	190	0.030	0.600	300	0.200	0.010	190	0.030
2008-010024	30,000	175	80	0.028	0.500	175	0.028	0.500	275	0.200	0.007	175	0.028
2010-003010	30,000	190	90	0.020	0.800	190	0.020	0.800	375	0.500	0.020	190	0.020
2010-003020	30,000	190	90	0.020	0.800	190	0.020	0.800	375	0.250	0.010	190	0.020
2010-003040	30,000	190	90	0.016	0.600	190	0.016	0.600	375	0.250	0.005	190	0.016
2010-003060	25,000	155	75	0.010	0.500	155	0.010	0.500	300	0.250	0.005	155	0.010
2010-005010	30,000	190	185	0.025	0.800	190	0.025	0.800	375	0.500	0.020	190	0.025
2010-005020	30,000	190	185	0.025	0.800	190	0.025	0.800	375	0.250	0.010	190	0.025
2010-005040	30,000	190	185	0.020	0.600	190	0.020	0.600	375	0.250	0.005	190	0.020
2010-005060	25,000	155	150	0.012	0.500	155	0.012	0.500	300	0.250	0.005	155	0.012
2010-010010	30,000	190	185	0.030	0.800	190	0.030	0.800	375	0.500	0.020	190	0.030
2010-010020	30,000	190	185	0.030	0.800	190	0.030	0.800	375	0.250	0.010	190	0.030
2010-010040	30,000	190	185	0.025	0.600	190	0.025	0.600	375	0.250	0.005	190	0.025
2010-010060	25,000	155	150	0.015	0.500	155	0.015	0.500	300	0.250	0.005	155	0.015
2015-003015	25,000	190	90	0.030	1.300	190	0.030	1.300	375	0.750	0.020	190	0.030
2015-003030	25,000	190	90	0.030	1.300	190	0.030	1.300	375	0.375	0.010	190	0.030
2015-005015	25,000	190	125	0.040	1.300	190	0.040	1.300	375	0.750	0.020	190	0.040
2015-005030	25,000	190	125	0.040	1.300	190	0.040	1.300	375	0.375	0.010	190	0.040
2015-010015	25,000	190	150	0.045	1.300	190	0.045	1.300	375	0.750	0.020	190	0.045
2015-010030	25,000	190	150	0.045	1.300	190	0.045	1.300	375	0.375	0.010	190	0.045
2015-010040	25,000	190	150	0.043	1.200	190	0.043	1.200	350	0.375	0.008	190	0.043
2015-010060	25,000	190	150	0.040	1.000	190	0.040	1.000	350	0.375	0.005	190	0.040

UDCLRSF Milling Conditions

Refer to page 22 for UDCLRSF note.

WORK MATERIAL	CEMENTED CARBIDE (<87HRA)												
Model Number	Spindle Speed (min^{-1})	Z-Level Milling				Flat Milling			Side Milling			Slotting	
		Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)
2003-003006	21,000	300	50	0.015	0.200	300	0.015	0.200	200	0.075	0.003	300	0.015
2003-005006	21,000	300	50	0.020	0.200	300	0.020	0.200	200	0.075	0.003	300	0.020
2005-003005	16,000	500	160	0.020	0.400	500	0.020	0.400	800	0.250	0.005	500	0.020
2005-003010	16,000	500	160	0.020	0.400	500	0.020	0.400	400	0.125	0.005	500	0.020
2005-003015	16,000	375	120	0.014	0.300	375	0.014	0.300	300	0.125	0.005	375	0.014
2005-005005	16,000	500	160	0.025	0.400	500	0.025	0.400	800	0.250	0.005	500	0.025
2005-005010	16,000	500	160	0.025	0.400	500	0.025	0.400	400	0.125	0.005	500	0.025
2005-005015	16,000	375	120	0.017	0.300	375	0.017	0.300	300	0.125	0.005	375	0.017
2008-003008	13,000	390	130	0.020	0.600	390	0.020	0.600	1200	0.400	0.008	390	0.020
2008-003016	13,000	390	130	0.020	0.600	390	0.020	0.600	600	0.200	0.008	390	0.020
2008-003024	13,000	350	120	0.014	0.500	350	0.014	0.500	540	0.200	0.006	350	0.014
2008-005008	13,000	390	130	0.025	0.600	390	0.025	0.600	1200	0.400	0.008	390	0.025
2008-005016	13,000	390	130	0.025	0.600	390	0.025	0.600	600	0.200	0.008	390	0.025
2008-005024	13,000	350	120	0.017	0.500	350	0.017	0.500	540	0.200	0.006	350	0.017
2008-010008	13,000	390	130	0.030	0.600	390	0.030	0.600	1200	0.400	0.008	390	0.030
2008-010016	13,000	390	130	0.030	0.600	390	0.030	0.600	600	0.200	0.008	390	0.030
2008-010024	13,000	350	120	0.020	0.500	350	0.020	0.500	540	0.200	0.006	350	0.020
2010-003010	12,000	360	120	0.020	0.800	360	0.020	0.800	1440	0.500	0.010	360	0.020
2010-003020	12,000	360	120	0.020	0.800	360	0.020	0.800	720	0.250	0.010	360	0.020
2010-003040	10,000	300	100	0.012	0.700	300	0.012	0.700	600	0.250	0.008	300	0.012
2010-003060	10,000	300	100	0.008	0.700	300	0.008	0.700	600	0.250	0.006	300	0.008
2010-005010	12,000	360	120	0.025	0.800	360	0.025	0.800	1440	0.500	0.010	360	0.025
2010-005020	12,000	360	120	0.025	0.800	360	0.025	0.800	720	0.250	0.010	360	0.025
2010-005040	10,000	300	100	0.015	0.700	300	0.015	0.700	600	0.250	0.008	300	0.015
2010-005060	10,000	300	100	0.010	0.700	300	0.010	0.700	600	0.250	0.006	300	0.010
2010-010010	12,000	360	120	0.030	0.800	360	0.030	0.800	1440	0.500	0.010	360	0.030
2010-010020	12,000	360	120	0.030	0.800	360	0.030	0.800	720	0.250	0.010	360	0.030
2010-010040	10,000	300	100	0.020	0.700	300	0.020	0.700	600	0.250	0.008	300	0.020
2010-010060	10,000	300	100	0.012	0.700	300	0.012	0.700	600	0.250	0.006	300	0.012
2015-003015	11,000	330	110	0.030	1.300	330	0.030	1.300	1440	0.750	0.010	330	0.030
2015-003030	11,000	330	110	0.030	1.300	330	0.030	1.300	720	0.375	0.010	330	0.030
2015-005015	11,000	330	110	0.040	1.300	330	0.040	1.300	1440	0.750	0.010	330	0.040
2015-005030	11,000	330	110	0.040	1.300	330	0.040	1.300	720	0.375	0.010	330	0.040
2015-010015	11,000	330	110	0.045	1.300	330	0.045	1.300	1440	0.750	0.010	330	0.045
2015-010030	11,000	330	110	0.045	1.300	330	0.045	1.300	720	0.375	0.010	330	0.045
2015-010040	11,000	330	110	0.045	1.100	330	0.045	1.100	720	0.375	0.010	330	0.045
2015-010060	11,000	330	110	0.030	1.100	330	0.030	1.100	720	0.375	0.009	330	0.030

UDCLRSF Milling Conditions

Refer to page 22 for UDCLRSF note.

WORK MATERIAL	CEMENTED CARBIDE (≧87HRA) / HARD BRITTLE MATERIALS												
Model Number	Spindle Speed (min^{-1})	Z-Level Milling				Flat Milling			Side Milling			Slotting	
		Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)
2020-003020	20,000	190	90	0.040	1.800	190	0.040	1.800	375	1.000	0.020	190	0.040
2020-003040	20,000	190	90	0.040	1.800	190	0.040	1.800	375	0.500	0.010	190	0.040
2020-003060	20,000	190	90	0.037	1.700	190	0.037	1.700	325	0.500	0.007	190	0.037
2020-003080	20,000	190	90	0.030	1.500	190	0.030	1.500	325	0.500	0.005	190	0.030
2020-003100	20,000	190	90	0.025	1.300	190	0.025	1.300	300	0.500	0.005	190	0.025
2020-005020	20,000	190	90	0.050	1.800	190	0.050	1.800	375	1.000	0.020	190	0.050
2020-005040	20,000	190	90	0.050	1.800	190	0.050	1.800	375	0.500	0.010	190	0.050
2020-005060	20,000	190	90	0.045	1.700	190	0.045	1.700	325	0.500	0.007	190	0.045
2020-005080	20,000	190	90	0.040	1.500	190	0.040	1.500	325	0.500	0.005	190	0.040
2020-005100	20,000	190	90	0.028	1.300	190	0.028	1.300	300	0.500	0.005	190	0.028
2020-010020	20,000	190	125	0.060	1.800	190	0.060	1.800	375	1.000	0.020	190	0.060
2020-010040	20,000	190	125	0.060	1.800	190	0.060	1.800	375	0.500	0.010	190	0.060
2020-010060	20,000	190	125	0.055	1.700	190	0.055	1.700	325	0.500	0.007	190	0.055
2020-010080	20,000	190	125	0.045	1.500	190	0.045	1.500	325	0.500	0.005	190	0.045
2020-010100	20,000	190	125	0.033	1.300	190	0.033	1.300	300	0.500	0.005	190	0.033

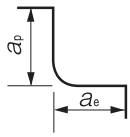
UDCLRSF Milling Conditions

Refer to page 22 for UDCLRSF note.

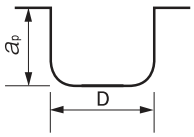
WORK MATERIAL	CEMENTED CARBIDE (<87HRA)												
Model Number	Spindle Speed (min^{-1})	Z-Level Milling				Flat Milling			Side Milling			Slotting	
		Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)
2020-003020	10,000	300	100	0.040	1.800	300	0.040	1.800	1440	1.000	0.010	300	0.040
2020-003040	10,000	300	100	0.040	1.800	300	0.040	1.800	1440	1.000	0.010	300	0.040
2020-003060	10,000	300	100	0.036	1.600	300	0.036	1.600	1440	0.500	0.010	300	0.036
2020-003080	10,000	300	100	0.023	1.600	300	0.023	1.600	1440	0.500	0.009	300	0.023
2020-003100	10,000	300	100	0.018	1.600	300	0.018	1.600	1440	0.500	0.009	300	0.018
2020-005020	10,000	300	100	0.050	1.800	300	0.050	1.800	1440	1.000	0.010	300	0.050
2020-005040	10,000	300	100	0.050	1.800	300	0.050	1.800	1440	1.000	0.010	300	0.050
2020-005060	10,000	300	100	0.045	1.600	300	0.045	1.600	1440	0.500	0.010	300	0.045
2020-005080	10,000	300	100	0.028	1.600	300	0.028	1.600	1440	0.500	0.009	300	0.028
2020-005100	10,000	300	100	0.020	1.600	300	0.020	1.600	1440	0.500	0.009	300	0.020
2020-010020	10,000	300	100	0.060	1.800	300	0.060	1.800	1440	1.000	0.010	300	0.060
2020-010040	10,000	300	100	0.060	1.800	300	0.060	1.800	1440	1.000	0.010	300	0.060
2020-010060	10,000	300	100	0.054	1.600	300	0.054	1.600	1440	0.500	0.010	300	0.054
2020-010080	10,000	300	100	0.034	1.600	300	0.034	1.600	1440	0.500	0.009	300	0.034
2020-010100	10,000	300	100	0.023	1.600	300	0.023	1.600	1440	0.500	0.009	300	0.023

These milling parameters are based on VF-20, VM-40, VU-70 (CIS standard) and are for reference only.
Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.
For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

*Feed Rate2: Feed Rate of Approach and *Connection links.
*Changing from one engagement point to the next.



Z-Level / Side / Flat Milling
a_p : Axial Depth (mm)
a_p : Radial Depth (mm)



Slotting
a_p : Axial Depth (mm)
D : Tool Outside Diameter

UDCLRSF Note

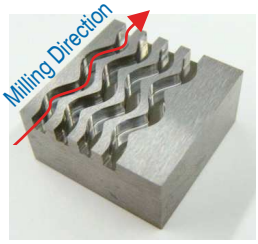
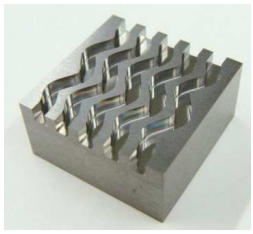
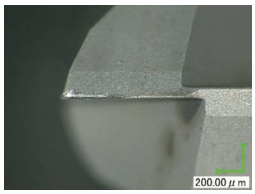
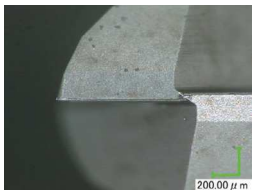
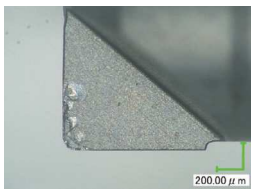
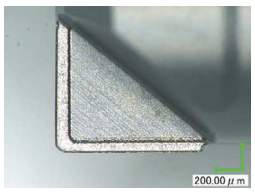
Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Does not require to be slowed down in the approach sequence when slotting and side milling.
- Use an inclined or helical approach when Z-level milling (Recommended inclination angle: <1 degree).
- For flat and side milling, set the axial depth (ap) and radial depth (ae) to allow for the uncut material of the corner radius.
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Higher efficiency and longer tool life!

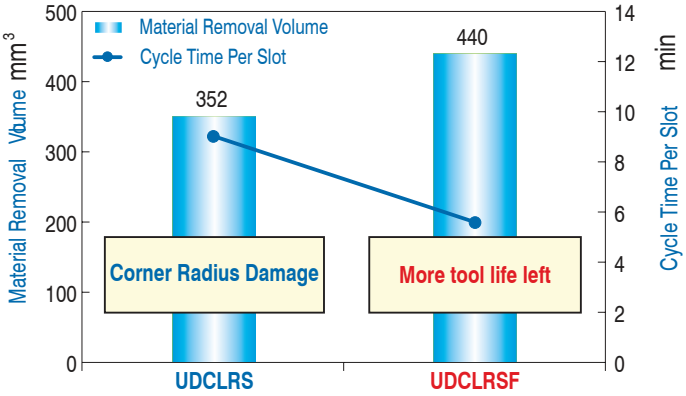
UDCLRSF Ø2×CR0.1
Cemented Carbide Curve Slotting Milling Example

VM-40 (90HRA)

	UDCLRS	UDCLRSF
Work Material		
Rake Face	 After 4 slots	 After 5 slots
Relief	 After 4 slots	 After 5 slots

Size : 20 × 20 × 10 mm
Slot Size : Width 2 × Depth 1.99 mm

Tool	UDCLRS 2020-010-020	UDCLRSF 2020-010020
Spindle Speed	20,000 min^{-1}	
Feed Rate	375 mm/min	190 mm/min
a_p Axial Depth	0.02 mm	0.06 mm
Coolant	Nozzle Air Blow	
Cycle Time (Per slot)	9 min 4 sec	5 min 36 sec

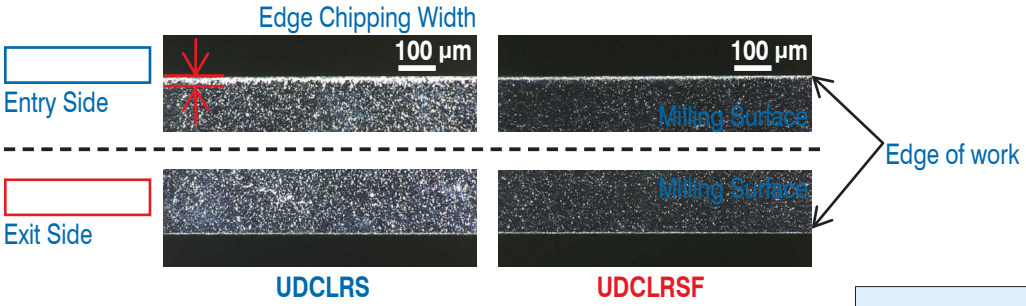


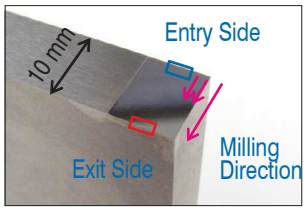
Minimizing Edge Chipping

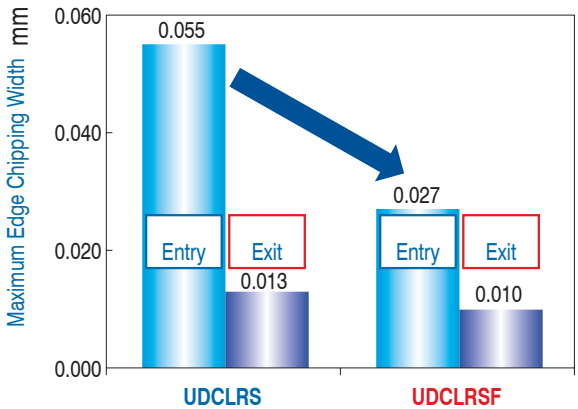
UDCLRSF Ø2 × CR0.03 × 2
Cemented Carbide Bottom Surface Milling Example

VM-40 (90HRA)

Edge Chipping Comparison on Work Material







Tool	UDCLRS 2020-003-020 UDCLRSF 2020-003020
Spindle Speed	20,000 min^{-1}
Feed Rate	100 mm/min
a_p Axial Depth	0.01 mm
a_e Radial Depth	0.01 mm
Coolant	Oil Mist
Cycle Time	137 min

Size **R0.1～R3**

UDCB

MG | UDC | 0° | R ±0.01 | Shank Dia 0/-0.005

Material Applications （☆ Highly Recommended ◎ Recommended ○ Suggested）

Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○ *1			☆	◎ *2

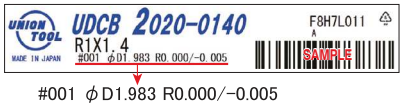
*1 DCB / DCLB series are highly recommended for Glass Filled Plastic milling.

*2 Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

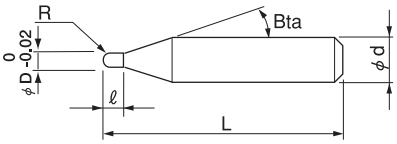
Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials.
Developed to give improved hardness and durability, new Diamond coating also has outstanding adhesion to the cutting tool.
Achieve remarkable cutting depth with optimum tool geometry.
Leaves a burr and pit free surface finish on semi-roughing & finishing process.

Label Sample



#001 φD1.983 R0.000/−0.005

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 14 models

Unit （mm）

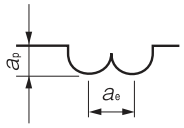
Model Number	Radius of Ball Nose R	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥
UDCB 2002-0014	R0.1	0.14	16°	50	4	39,160
UDCB 2003-0021	R0.15	0.21	16°	50	4	39,160
UDCB 2004-0028	R0.2	0.28	16°	50	4	35,660
UDCB 2005-0035	R0.25	0.35	16°	50	4	35,660
UDCB 2006-0042	R0.3	0.42	16°	50	4	32,000
UDCB 2007-0049	R0.35	0.49	16°	50	4	32,000
UDCB 2008-0056	R0.4	0.56	16°	50	4	32,000
UDCB 2009-0063	R0.45	0.63	16°	50	4	32,000
UDCB 2010-0070	R0.5	0.7	16°	50	4	32,000
UDCB 2020-0140	R1	1.4	16°	50	4	32,000
UDCB 2030-0210	R1.5	2.1	16°	60	6	35,160
UDCB 2040-0280	R2	2.8	16°	60	6	35,160
UDCB 2050-0350	R2.5	3.5	16°	60	6	35,160
UDCB 2060-0420	R3	4.2	⊠	60	6	35,160

UDCB Milling Conditions

WORK MATERIAL			CEMENTED CARBIDE（≧87HRA）					CEMENTED CARBIDE（＜87HRA）					HARD BRITTLE MATERIALS				
Model Number	Radius of Ball Nose (mm)	Length of Cut (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
2002-0014	**R0.1**	0.14	30,000	100	10	0.01	0.01	30,000	100	10	0.01	0.01	30,000	100	10	0.01	0.01
2003-0021	**R0.15**	0.21	30,000	125	13	0.015	0.03	30,000	125	13	0.015	0.03	30,000	125	13	0.015	0.03
2004-0028	**R0.2**	0.28	30,000	150	15	0.02	0.08	30,000	150	15	0.02	0.08	30,000	150	15	0.02	0.08
2005-0035	**R0.25**	0.35	30,000	175	18	0.025	0.11	30,000	175	18	0.025	0.11	30,000	175	18	0.025	0.11
2006-0042	**R0.3**	0.42	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14
2007-0049	**R0.35**	0.49	30,000	225	23	0.035	0.17	30,000	225	23	0.035	0.17	30,000	225	23	0.035	0.17
2008-0056	**R0.4**	0.56	30,000	250	25	0.04	0.19	30,000	250	25	0.04	0.19	30,000	250	25	0.04	0.19
2009-0063	**R0.45**	0.63	30,000	275	28	0.045	0.22	30,000	275	28	0.045	0.22	30,000	275	28	0.045	0.22
2010-0070	**R0.5**	0.7	30,000	300	30	0.05	0.25	20,000	400	200	0.35	0.075	30,000	300	30	0.05	0.25
2020-0140	**R1**	1.4	30,000	300	100	0.1	0.3	16,500	420	210	0.25	0.10	24,000	240	100	0.1	0.3
2030-0210	**R1.5**	2.1	27,500	275	140	0.125	0.33	11,000	280	140	0.38	0.15	24,000	240	120	0.125	0.33
2040-0280	**R2**	2.8	24,000	240	120	0.15	0.35	8,250	300	150	0.5	0.20	24,000	240	120	0.15	0.35
2050-0350	**R2.5**	3.5	22,000	220	110	0.175	0.37	6,600	330	160	0.6	0.25	22,000	220	110	0.175	0.37
2060-0420	**R3**	4.2	20,000	200	100	0.2	0.4	5,500	280	140	0.65	0.28	20,000	200	100	0.2	0.4

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (CIS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.
Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

*Feed Rate2: Feed Rate of Approach and *Connection links.
*Changing from one engagement point to the next.



a_p : Axial Depth（mm）
a_e : Radial Depth（mm）

Hexagonal Pyramid Milling Video
【VF-20（92.5HRA）】

Pyramid Milling Video
【VM-40（90HRA）】

Hexalobular Milling Video
【VF-20（92.5HRA）】

Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Size **R0.1～R3**

UDCLB

MG | UDC | 0° | R ±0.01 | Shank Dia 0/-0.005

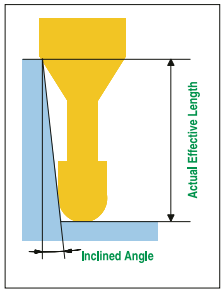
Material Applications （☆ Highly Recommended ◎ Recommended ○ Suggested）

Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○ *1			☆	◎ *2

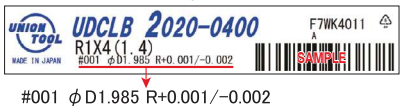
*1 DCB / DCLB series are highly recommended for Glass Filled Plastic milling.
*2 Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

Long Neck Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials.
Developed to give improved hardness and durability, new Diamond coating also has outstanding adhesion to the cutting tool.
Achieve remarkable cutting depth with optimum tool geometry.
Leaves a burr and pit free surface finish on semi-roughing & finishing process.

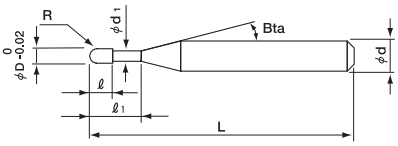


Label Sample



#001 φD1.985 R+0.001/−0.002

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 37 models

Unit （mm）

Model Number	Radius of Ball Nose R	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°
UDCLB 2002-0030	R0.1	0.3	0.14	0.18	16°	50	4	39,580	0.30	0.31	0.32	0.32	0.34
UDCLB 2002-0050		0.5				50	4	39,580	0.51	0.52	0.54	0.55	0.59
UDCLB 2002-0075		0.75				50	4	39,580	0.77	0.79	0.81	0.84	0.89
UDCLB 2002-0100		1				50	4	39,580	1.02	1.05	1.09	1.12	1.20
UDCLB 2004-0050	R0.2	0.5	0.28	0.36	16°	50	4	36,080	0.54	0.55	0.56	0.58	0.61
UDCLB 2004-0100		1				50	4	36,080	1.06	1.08	1.12	1.15	1.22
UDCLB 2004-0150		1.5				50	4	36,080	1.57	1.62	1.67	1.72	1.83
UDCLB 2004-0200		2				50	4	36,080	2.09	2.15	2.22	2.29	2.44
UDCLB 2006-0100	R0.3	1	0.42	0.56	16°	50	4	32,410	1.05	1.08	1.11	1.13	1.20
UDCLB 2006-0150		1.5				50	4	32,410	1.57	1.61	1.66	1.70	1.81
UDCLB 2006-0200		2				50	4	32,410	2.08	2.14	2.21	2.27	2.42
UDCLB 2006-0300		3				50	4	32,410	3.12	3.21	3.31	3.41	3.65
UDCLB 2008-0200	R0.4	2	0.56	0.76	16°	50	4	32,410	2.08	2.14	2.20	2.26	2.40
UDCLB 2008-0300		3				50	4	32,410	3.11	3.20	3.30	3.40	3.62
UDCLB 2008-0400		4				50	4	32,410	4.14	4.27	4.40	4.54	4.85

2 Flutes Long Neck Ball End Mills for Cemented Carbide and Hard Brittle Materials

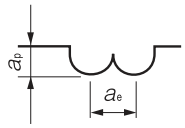
Model Number	Radius of Ball Nose R	Effective Length ℓ_1	Length of Cut ℓ	Neck Diameter Ø d_1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles				
									30′	1°	1°30′	2°	3°
UDCLB 2010-0200	R0.5	2	0.7	0.96	16°	50	4	32,410	2.08	2.13	2.19	2.25	2.38
UDCLB 2010-0250		2.5				50	4	32,410	2.59	2.66	2.74	2.81	2.99
UDCLB 2010-0300		3				50	4	32,410	3.11	3.20	3.29	3.38	3.60
UDCLB 2010-0400		4				50	4	32,410	4.14	4.26	4.39	4.52	4.83
UDCLB 2010-0500		5				50	4	32,410	5.17	5.32	5.49	5.66	6.05
UDCLB 2020-0300	R1	3	1.4	1.9	16°	50	4	32,410	3.20	3.27	3.35	3.43	3.62
UDCLB 2020-0400		4				50	4	32,410	4.23	4.34	4.45	4.57	4.84
UDCLB 2020-0600		6				50	4	32,410	6.30	6.47	6.65	6.85	7.29
UDCLB 2020-0800		8				50	4	32,410	8.36	8.60	8.85	9.13	9.74
UDCLB 2020-1000		10				50	4	32,410	10.42	10.73	11.06	11.41	12.19
UDCLB 2030-0600	R1.5	6	2.1	2.9	16°	60	6	35,580	6.28	6.44	6.60	6.78	7.18
UDCLB 2030-0800		8				60	6	35,580	8.34	8.57	8.80	9.06	9.63
UDCLB 2030-1000		10				60	6	35,580	10.41	10.70	11.01	11.34	12.08
UDCLB 2030-1200		12				60	6	35,580	12.47	12.83	13.21	13.61	14.52
UDCLB 2030-1400		14				60	6	35,580	14.53	14.96	15.41	15.89	16.97
UDCLB 2040-0800	R2	8	2.8	3.9	16°	60	6	35,580	8.33	8.53	8.76	8.99	9.52
UDCLB 2040-1000		10				60	6	35,580	10.39	10.66	10.96	11.27	11.97
UDCLB 2040-1500		15				60	6	35,580	15.55	15.99	16.46	16.96	18.09
UDCLB 2050-1000	R2.5	10	3.5	4.8	16°	60	6	35,580	10.55	10.82	11.10	11.40	12.07
UDCLB 2050-1500		15				60	6	35,580	15.71	16.14	16.60	17.09	No Interference
UDCLB 2060-1000	R3	10	4.2	5.7	☒	60	6	35,580	No Interference	No Interference	No Interference	No Interference	No Interference
UDCLB 2060-1500		15				60	6	35,580	No Interference	No Interference	No Interference	No Interference	No Interference

UDCLB Milling Conditions

WORK MATERIAL			CEMENTED CARBIDE (≧87HRA)					CEMENTED CARBIDE (＜87HRA)					HARD BRITTLE MATERIALS				
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
2002-0030	R0.1	0.3	30,000	100	10	0.01	0.01	30,000	100	10	0.01	0.01	30,000	100	10	0.01	0.01
2002-0050		0.5	30,000	30	10	0.005	0.008	30,000	30	10	0.005	0.008	30,000	30	10	0.005	0.008
2002-0075		0.75	30,000	30	10	0.005	0.006	30,000	30	10	0.005	0.006	30,000	30	10	0.005	0.006
2002-0100		1	30,000	25	10	0.005	0.005	30,000	25	10	0.005	0.005	30,000	25	10	0.005	0.005
2004-0050	R0.2	0.5	30,000	150	15	0.02	0.08	30,000	150	15	0.02	0.08	30,000	150	15	0.02	0.08
2004-0100		1	30,000	100	10	0.015	0.07	30,000	100	10	0.015	0.07	30,000	100	10	0.015	0.07
2004-0150		1.5	30,000	60	10	0.01	0.06	30,000	60	10	0.01	0.06	30,000	60	10	0.01	0.06
2004-0200		2	30,000	30	10	0.008	0.05	30,000	30	10	0.008	0.05	30,000	30	10	0.008	0.05
2006-0100	R0.3	1	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14
2006-0150		1.5	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14	30,000	200	20	0.03	0.14
2006-0200		2	30,000	150	15	0.022	0.11	30,000	150	15	0.022	0.11	30,000	150	15	0.022	0.11
2006-0300		3	30,000	75	10	0.01	0.08	30,000	75	10	0.01	0.08	30,000	75	10	0.01	0.08
2008-0200	R0.4	2	30,000	250	25	0.04	0.19	30,000	250	25	0.04	0.19	30,000	250	25	0.04	0.19
2008-0300		3	30,000	230	23	0.037	0.17	30,000	230	23	0.037	0.17	30,000	230	23	0.037	0.17
2008-0400		4	30,000	210	21	0.035	0.16	30,000	210	21	0.035	0.16	30,000	210	21	0.035	0.16
2010-0200	R0.5	2	30,000	300	30	0.05	0.25	20,000	400	200	0.35	0.075	30,000	300	30	0.05	0.25
2010-0250		2.5	30,000	300	30	0.05	0.25	20,000	400	200	0.35	0.075	30,000	300	30	0.05	0.25
2010-0300		3	30,000	300	30	0.05	0.25	20,000	400	200	0.35	0.075	30,000	300	30	0.05	0.25
2010-0400		4	30,000	300	30	0.05	0.25	20,000	400	200	0.3	0.07	30,000	300	30	0.05	0.25
2010-0500		5	30,000	300	30	0.05	0.25	20,000	400	200	0.3	0.07	30,000	300	30	0.05	0.25
2020-0300	R1	3	30,000	300	100	0.1	0.3	16,500	420	210	0.25	0.1	24,000	240	100	0.1	0.3
2020-0400		4	30,000	300	100	0.1	0.3	16,500	420	210	0.25	0.1	24,000	240	100	0.1	0.3
2020-0600		6	30,000	300	100	0.1	0.3	16,500	420	210	0.25	0.1	24,000	240	100	0.1	0.3
2020-0800		8	30,000	300	100	0.1	0.3	16,500	420	210	0.25	0.1	24,000	240	100	0.1	0.3
2020-1000		10	30,000	300	100	0.1	0.3	16,500	420	210	0.25	0.1	24,000	240	100	0.1	0.3
2030-0600	R1.5	6	27,500	275	140	0.125	0.33	11,000	280	140	0.38	0.15	24,000	240	120	0.125	0.33
2030-0800		8	27,500	275	140	0.125	0.33	11,000	280	140	0.38	0.15	24,000	240	120	0.125	0.33
2030-1000		10	27,500	275	140	0.125	0.33	11,000	280	140	0.3	0.15	24,000	240	120	0.125	0.33
2030-1200		12	27,500	220	110	0.125	0.33	11,000	280	140	0.3	0.15	24,000	200	100	0.125	0.33
2030-1400		14	27,500	220	110	0.125	0.33	11,000	280	140	0.3	0.15	24,000	200	100	0.125	0.33
2040-0800	R2	8	24,000	240	120	0.15	0.35	8,250	300	150	0.5	0.2	24,000	240	120	0.15	0.35
2040-1000		10	24,000	240	120	0.15	0.35	8,250	300	150	0.5	0.2	24,000	240	120	0.15	0.35
2040-1500		15	24,000	240	120	0.15	0.35	8,250	300	150	0.5	0.2	24,000	240	120	0.15	0.35
2050-1000	R2.5	10	22,000	220	110	0.175	0.37	6,600	330	160	0.6	0.25	22,000	220	110	0.175	0.37
2050-1500		15	22,000	220	110	0.175	0.37	6,600	330	160	0.6	0.25	22,000	220	110	0.175	0.37
2060-1000	R3	10	20,000	200	100	0.2	0.4	5,500	280	140	0.65	0.28	20,000	200	100	0.2	0.4
2060-1500		15	20,000	200	100	0.2	0.4	5,500	280	140	0.65	0.28	20,000	200	100	0.2	0.4

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (CIS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.
Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

*Feed Rate2: Feed Rate of Approach and *Connection links.
*Changing from one engagement point to the next.



a_p : Axial Depth (mm)
a_e : Radial Depth (mm)

UDCLB Note

Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Size ϕ0.3～ϕ2

UDCLRS

Material Applications (☆ Highly Recommended ◎ Recommended ○ Suggested)

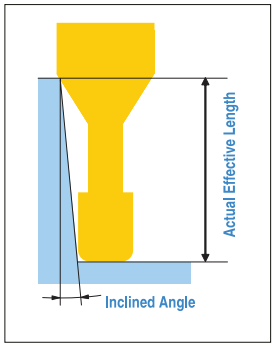
Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○ *1			☆	◎ *2

*1 UDCLRSF is highly recommended for Glass Filled Plastic milling.

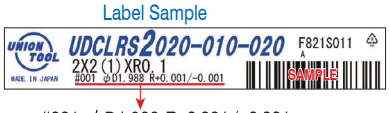
*2 Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

Long Neck Radius type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials.
Developed to give improved hardness and durability, new Diamond coating also has outstanding adhesion to the cutting tool.
Achieve remarkable cutting depth with optimum tool geometry.
Leaves a burr and pit free surface finish on semi-roughing & finishing process.

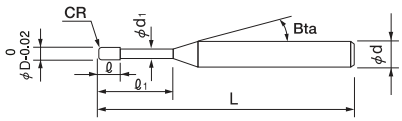


Label Sample



#001 ϕD1.988 R+0.001/−0.001

Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 30 models

Unit (mm)

Model Number	Outside Diameter ØD	Coner Radius CR	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°
UDCLRS 2003-003-006	0.3	R0.03	0.6	0.15	0.28	16°	50	4	45,500	0.61	0.63	0.65	0.67	0.72
UDCLRS 2003-005-006		R0.05	0.6				50	4	45,500	0.61	0.63	0.65	0.67	0.72
UDCLRS 2005-003-005	0.5	R0.03	0.5	0.25	0.46	16°	50	4	43,300	0.55	0.56	0.58	0.60	0.64
UDCLRS 2005-003-010			1				50	4	43,300	1.06	1.10	1.13	1.17	1.25
UDCLRS 2005-005-005		R0.05	0.5				50	4	43,300	0.55	0.56	0.58	0.60	0.64
UDCLRS 2005-005-010			1				50	4	43,300	1.06	1.09	1.13	1.17	1.25
UDCLRS 2008-003-008	0.8	R0.03	0.8	0.4	0.76	16°	50	4	38,900	0.86	0.88	0.91	0.94	1.01
UDCLRS 2008-003-016			1.6				50	4	38,900	1.68	1.73	1.79	1.85	1.99
UDCLRS 2008-005-008		R0.05	0.8				50	4	38,900	0.85	0.88	0.91	0.94	1.01
UDCLRS 2008-005-016			1.6				50	4	38,900	1.68	1.73	1.79	1.85	1.98
UDCLRS 2008-010-008		R0.1	0.8				50	4	38,900	0.85	0.88	0.90	0.93	0.99
UDCLRS 2008-010-016			1.6				50	4	38,900	1.68	1.73	1.78	1.84	1.97
UDCLRS 2010-003-010	1	R0.03	1	0.5	0.96	16°	50	4	38,900	1.06	1.10	1.13	1.17	1.25
UDCLRS 2010-003-020			2				50	4	38,900	2.09	2.16	2.23	2.31	2.48
UDCLRS 2010-005-010		R0.05	1				50	4	38,900	1.06	1.09	1.13	1.17	1.25
UDCLRS 2010-005-020			2				50	4	38,900	2.09	2.16	2.23	2.31	2.47
UDCLRS 2010-010-010		R0.1	1				50	4	38,900	1.06	1.09	1.12	1.16	1.24
UDCLRS 2010-010-020			2				50	4	38,900	2.09	2.16	2.22	2.30	2.46

2 Flutes Long Neck Radius End Mills for Cemented Carbide and Hard Brittle Materials

Model Number	Outside Diameter ØD	Coner Radius CR	Effective Length ℓ_1	Length of Cut ℓ	Neck Diameter $Ød_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥	Effective Length by Inclined Angles				
										30′	1°	1°30′	2°	3°
UDCLRS 2015-003-015	1.5	R0.03	1.5	0.75	1.44	16°	50	4	38,900	1.61	1.66	1.72	1.78	1.91
UDCLRS 2015-003-030			3				50	4	38,900	3.16	3.26	3.37	3.49	3.74
UDCLRS 2015-005-015		R0.05	1.5				50	4	38,900	1.61	1.66	1.72	1.78	1.90
UDCLRS 2015-005-030			3				50	4	38,900	3.16	3.26	3.37	3.48	3.74
UDCLRS 2015-010-015		R0.1	1.5				50	4	38,900	1.61	1.66	1.71	1.77	1.89
UDCLRS 2015-010-030			3				50	4	38,900	3.16	3.26	3.36	3.48	3.73
UDCLRS 2020-003-020	2	R0.03	2	1	1.9	16°	50	4	38,900	2.20	2.27	2.35	2.43	2.61
UDCLRS 2020-003-040			4				50	4	38,900	4.26	4.40	4.55	4.70	5.05
UDCLRS 2020-005-020		R0.05	2				50	4	38,900	2.20	2.27	2.34	2.42	2.60
UDCLRS 2020-005-040			4				50	4	38,900	4.26	4.40	4.55	4.70	5.05
UDCLRS 2020-010-020		R0.1	2				50	4	38,900	2.20	2.27	2.34	2.42	2.59
UDCLRS 2020-010-040			4				50	4	38,900	4.26	4.40	4.54	4.69	5.04

UDCLRS Milling Conditions

Refer to page 34 for UDCLRS note.

WORK MATERIAL	CEMENTED CARBIDE (≧87HRA) / HARD BRITTLE MATERIALS												
Model Number	Spindle Speed (min^{-1})	Z-Level Milling				Flat Milling			Side Milling			Slotting	
		Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)
2003-003-006	30,000	220	50	0.010	0.200	220	0.010	0.200	110	0.050	0.001	110	0.010
2003-005-006	30,000	220	50	0.010	0,200	220	0.010	0.200	110	0.050	0.001	110	0.010
2005-003-005	30,000	185	90	0.010	0.400	185	0.010	0.400	375	0.250	0.005	375	0.010
2005-003-010	30,000	185	90	0.010	0.400	185	0.010	0.400	180	0.125	0.005	375	0.010
2005-005-005	30,000	375	125	0.010	0.400	375	0.010	0.400	375	0.250	0.005	375	0.010
2005-005-010	30,000	375	125	0.010	0.400	375	0.010	0.400	180	0.125	0.005	375	0.010
2008-003-008	30,000	185	90	0.010	0.600	185	0.010	0.600	600	0.400	0.008	375	0.010
2008-003-016	30,000	185	90	0.010	0.600	185	0.010	0.600	300	0.200	0.008	375	0.010
2008-005-008	30,000	375	150	0.010	0.600	375	0.010	0.600	600	0.400	0.008	375	0.010
2008-005-016	30,000	375	150	0.010	0.600	375	0.010	0.600	300	0.200	0.008	375	0.010
2008-010-008	30,000	375	150	0.010	0.600	375	0.010	0.600	600	0.400	0.008	375	0.010
2008-010-016	30,000	375	150	0.010	0.600	375	0.010	0.600	300	0.200	0.008	375	0.010
2010-003-010	30,000	185	90	0.010	0.800	185	0.010	0.800	750	0.500	0.010	375	0.010
2010-003-020	30,000	185	90	0.010	0.800	185	0.010	0.800	375	0.250	0.010	375	0.010
2010-005-010	30,000	375	185	0.010	0.800	375	0.010	0.800	750	0.500	0.010	375	0.010
2010-005-020	30,000	375	185	0.010	0.800	375	0.010	0.800	375	0.250	0.010	375	0.010
2010-010-010	30,000	375	185	0.010	0.800	375	0.010	0.800	750	0.500	0.010	375	0.010
2010-010-020	30,000	375	185	0.010	0.800	375	0.010	0.800	375	0.250	0.010	375	0.010
2015-003-015	25,000	185	90	0.010	1.300	185	0.010	1.300	750	0.750	0.010	375	0.015
2015-003-030	25,000	185	90	0.010	1.300	185	0.010	1.300	375	0.375	0.010	375	0.015
2015-005-015	25,000	375	125	0.015	1.300	375	0.015	1.300	750	0.750	0.010	375	0.015
2015-005-030	25,000	375	125	0.015	1.300	375	0.015	1.300	375	0.375	0.010	375	0.015
2015-010-015	25,000	375	150	0.015	1.300	375	0.015	1.300	750	0.750	0.010	375	0.015
2015-010-030	25,000	375	150	0.015	1.300	375	0.015	1.300	375	0.375	0.010	375	0.015
2020-003-020	20,000	185	90	0.010	1.800	185	0.010	1.800	750	1.000	0.010	375	0.020
2020-003-040	20,000	185	90	0.010	1.800	185	0.010	1.800	375	0.500	0.010	375	0.020
2020-005-020	20,000	375	90	0.020	1.800	375	0.020	1.800	750	1.000	0.010	375	0.020
2020-005-040	20,000	375	90	0.020	1.800	375	0.020	1.800	375	0.500	0.010	375	0.020
2020-010-020	20,000	375	125	0.020	1.800	375	0.020	1.800	750	1.000	0.010	375	0.020
2020-010-040	20,000	375	125	0.020	1.800	375	0.020	1.800	375	0.500	0.010	375	0.020

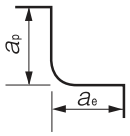
UDCLRS Milling Conditions

Refer to page 34 for UDCLRS note.

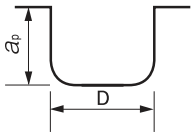
WORK MATERIAL	CEMENTED CARBIDE (<87HRA)												
Model Number	Spindle Speed (min^{-1})	Z-Level Milling				Flat Milling			Side Milling			Slotting	
		Feed Rate (mm/min)	* Feed Rate 2 (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)
2003-003-006	21,000	220	50	0.010	0.200	220	0.010	0.200	200	0.075	0.003	200	0.010
2003-005-006	21,000	220	50	0.010	0.200	220	0.010	0.200	200	0.075	0.003	200	0.010
2005-003-005	20,000	275	135	0.020	0.400	275	0.020	0.400	800	0.250	0.005	550	0.020
2005-003-010	20,000	275	135	0.020	0.400	275	0.020	0.400	400	0.125	0.005	550	0.020
2005-005-005	20,000	550	180	0.020	0.400	550	0.020	0.400	800	0.250	0.005	550	0.020
2005-005-010	20,000	550	180	0.020	0.400	550	0.020	0.400	400	0.125	0.005	550	0.020
2008-003-008	19,000	290	145	0.020	0.600	290	0.020	0.600	1,200	0.400	0.008	580	0.025
2008-003-016	19,000	290	145	0.020	0.600	290	0.020	0.600	600	0.200	0.008	580	0.025
2008-005-008	19,000	580	190	0.025	0.600	580	0.025	0.600	1,200	0.400	0.008	580	0.025
2008-005-016	19,000	580	190	0.025	0.600	580	0.025	0.600	600	0.200	0.008	580	0.025
2008-010-008	19,000	580	190	0.025	0.600	580	0.025	0.600	1,200	0.400	0.008	580	0.025
2008-010-016	19,000	580	190	0.025	0.600	580	0.025	0.600	600	0.200	0.008	580	0.025
2010-003-010	18,250	300	150	0.020	0.800	300	0.020	0.800	1,440	0.500	0.010	600	0.025
2010-003-020	18,250	300	150	0.020	0.800	300	0.020	0.800	720	0.250	0.010	600	0.025
2010-005-010	18,250	600	200	0.025	0.800	600	0.025	0.800	1,440	0.500	0.010	600	0.025
2010-005-020	18,250	600	200	0.025	0.800	600	0.025	0.800	720	0.250	0.010	600	0.025
2010-010-010	18,250	600	200	0.025	0.800	600	0.025	0.800	1,440	0.500	0.010	600	0.025
2010-010-020	18,250	600	200	0.025	0.800	600	0.025	0.800	720	0.250	0.010	600	0.025
2015-003-015	16,500	325	160	0.020	1.300	325	0.020	1.300	1,440	0.750	0.010	650	0.035
2015-003-030	16,500	325	160	0.020	1.300	325	0.020	1.300	720	0.375	0.010	650	0.035
2015-005-015	16,500	650	210	0.035	1.300	650	0.035	1.300	1,440	0.750	0.010	650	0.035
2015-005-030	16,500	650	210	0.035	1.300	650	0.035	1.300	720	0.375	0.010	650	0.035
2015-010-015	16,500	650	210	0.035	1.300	650	0.035	1.300	1,440	0.750	0.010	650	0.035
2015-010-030	16,500	650	210	0.035	1.300	650	0.035	1.300	720	0.375	0.010	650	0.035
2020-003-020	15,000	360	180	0.020	1.800	360	0.020	1.800	1,440	1.000	0.010	720	0.050
2020-003-040	15,000	360	180	0.020	1.800	360	0.020	1.800	1,440	1.000	0.010	720	0.050
2020-005-020	15,000	720	240	0.050	1.800	720	0.050	1.800	1,440	1.000	0.010	720	0.050
2020-005-040	15,000	720	240	0.050	1.800	720	0.050	1.800	1,440	1.000	0.010	720	0.050
2020-010-020	15,000	720	240	0.050	1.800	720	0.050	1.800	1,440	1.000	0.010	720	0.050
2020-010-040	15,000	720	240	0.050	1.800	720	0.050	1.800	1,440	1.000	0.010	720	0.050

These milling parameters are based on VF-20, VM-40, VU-70 (CIS standard) and are for reference only.
Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.
For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

*Feed Rate2: Feed Rate of Approach and *Connection links.
*Changing from one engagement point to the next.



Z-Level / Side / Flat Milling
a_p : Axial Depth (mm)
a_p : Radial Depth (mm)



Slotting
a_p : Axial Depth (mm)
D : Tool Outside Diameter

UDCLRS Note

Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Does not require to be slowed down in the approach sequence when slotting and side milling.
- Use an inclined or helical approach when Z-level milling (Recommended inclination angle: <1 degree).
- For flat and side milling, set the axial depth (ap) and radial depth (ae) to allow for the uncut material of the corner radius.
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

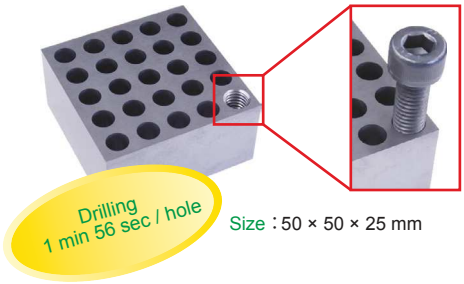
Introducing revolutionary new tools for "Direct Drilling & Thread Milling" on Cemented Carbide !!

New standard for Cemented Carbide Processing

- **Cracks are minimized.**
- **Time and cost savings comparing to EDM process.**
- **Highly precise thread geometry generated by single path threading.**

Cemented Carbide UDCMX Ø6.8 (Hole Before Threading) + UDCT M8 (Threading) VM-40 (90HRA)

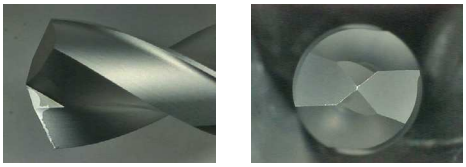
After drilling & threading Screw inserted



Size : 50 × 50 × 25 mm

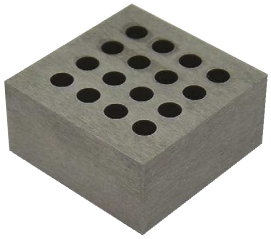
	Single-shot drilling	Threading
Tool	UDCMX 2680-250	UDCT M8-1.25-24
Spindle Speed	4,000 min^{-1}	3,500 min^{-1}
Feed Rate	12 mm/min	20 mm/min
Coolant	Air Blow (Nozzle)	
Hole Specification	Blind Hole 20 mm depth x 25 holes	Blind Hole 17.5 mm depth x 1 hole
Cycle Time	1 min 56 sec / per hole	5 min 36 sec / per hole

Tool after drilling



Cemented Carbide UDCMX Ø2.5 (Hole Before Threading) + UDCT M3 (Thread Milling) VM-40 (90HRA)

After drilling



After threading

Size : 20 x 20 x 10 mm

	Drilling	Threading
Tool	UDCMX 2250-100	UDCT M3-0.5-6
Spindle Speed	2,000 min^{-1}	20,000 min^{-1}
Feed Rate	5 mm/min	3 mm/min
Peck Amount	0.5 mm	—
Coolant	Air Blow (Nozzle)	
Hole Specification	Blind Hole 8 mm depth x 16 holes	Blind Hole 6 mm depth x 16 holes
Cycle Time	2 min 2 sec / per hole	9 min 15 sec / per hole

Size　φ0.3～φ7

UDCMX

MG　UDC　30°　X Thinning　Shank Dia 0/-0.005

Additional 7 Models

Material Applications（☆ Highly Recommended ◎ Recommended ○ Suggested）

Work Material															
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○			☆	◎ *

* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

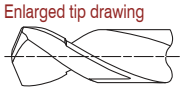
UDC offers excellent drilling performance on Cemented Carbide and Hard Brittle (Non-Metallic) Materials.
By combining the new coating with optimum tool geometry, the tool improves hole quality and longer tool life.
Makes mechanical drilling cost competitive!

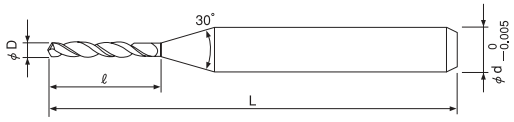
Label Sample

#001 φD5.999

Measured diameter is printed on the label.

Enlarged tip drawing





Point Angle：130°
Diameter Tolerance：0/-0.02（D ≤ 3.5）
0/-0.025（D ≥ 4）
* **Under-cut type**

Total 35 models

Unit（mm）

	Model Number	Diameter ØD	Flute Length ℓ	Overall Length L	Shank Diameter Ød	Price ¥	Cemented Carbide Spindle Speed (min⁻¹)	Cemented Carbide Feed Rate (mm/min)	Cemented Carbide Peck Amount (mm)
*	UDCMX 2030-030	0.3	3	38	3	18,000	28,750	5	0.05
	UDCMX 2040-040	0.4	4	38	3	18,000	20,000	5	0.05
	UDCMX 2050-050	0.5	5	38	3	18,000	15,000	5	0.05
	UDCMX 2060-060	0.6	6	38	3	18,000	11,500	5	0.05
	UDCMX 2070-070	0.7	7	38	3	18,000	9,000	5	0.05
	UDCMX 2080-080	0.8	8	38	3	18,000	7,300	7.5	0.05
	UDCMX 2090-090	0.9	9	38	3	18,000	6,000	7.5	0.05
	UDCMX 2100-100	1	10	38	3	18,000	5,000	7.5	0.05
	UDCMX 2110-100	1.1	10	38	3	18,000	4,500	7.2	0.06
	UDCMX 2120-100	1.2	10	38	3	18,000	4,100	6.8	0.07
	UDCMX 2130-100	1.3	10	38	3	18,000	3,750	6.5	0.08
	UDCMX 2140-100	1.4	10	38	3	18,000	3,450	6.2	0.09
	UDCMX 2150-100	1.5	10	38	3	18,000	3,200	6	0.1
	UDCMX 2160-100	1.6	10	38	3	18,000	3,000	6	0.1
*	UDCMX 2170-100	1.7	10	38	3	18,000	2,850	5.8	0.1
*	UDCMX 2180-100	1.8	10	38	3	18,000	2,700	5.5	0.1
*	UDCMX 2190-100	1.9	10	38	3	18,000	2,550	5.3	0.1
	UDCMX 2200-100	2	10	38	3	18,000	2,400	5	0.15
	UDCMX 2210-100	2.1	10	38	3	18,000	2,300	5	0.15
*	UDCMX 2220-100	2.2	10	38	3	18,000	2,225	5	0.15
*	UDCMX 2230-100	2.3	10	38	3	18,000	2,150	5	0.15
*	UDCMX 2240-100	2.4	10	38	3	18,000	2,075	5	0.15

* Additional model

2 Flutes Drills for Cemented Carbide and Hard Brittle Materials

Model Number	Diameter ØD	Flute Length ℓ	Overall Length L	Shank Diameter Ød	Price ¥	Cemented Carbide		
						Spindle Speed (min^{-1})	Feed Rate (mm/min)	Peck Amount (mm)
UDCMX 2250-100	2.5	10	38	3	18,000	2,000	5	0.2
UDCMX 2300-100	3	10	38	3	18,000	1,100	3.7	0.25
UDCMX 2330-120	3.3	12	50	4	20,000	1,000	3.4	0.3
UDCMX 2350-120	3.5	12	50	4	20,000	910	3.3	0.35
UDCMX 2400-160	4	16	60	6	35,500	4,000	6.9	Single-Shot
UDCMX 2420-160	4.2	16	60	6	35,500	4,000	7.3	Single-Shot
UDCMX 2450-200	4.5	20	60	6	35,500	4,000	7.8	Single-Shot
UDCMX 2500-200	5	20	60	6	35,500	4,000	8.7	Single-Shot
UDCMX 2550-250	5.5	25	80	6	38,000	4,000	9.6	Single-Shot
UDCMX 2600-250	6	25	80	6	38,000	4,000	10.5	Single-Shot
UDCMX 2650-250	6.5	25	80	8	48,000	4,000	11.5	Single-Shot
UDCMX 2680-250	6.8	25	80	8	52,000	4,000	12	Single-Shot
UDCMX 2700-250	7	25	80	8	52,000	4,000	12.4	Single-Shot

These milling parameters are based on VM-40 (CIS standard) and are for reference only.
Tool life may differ depending on the type of Cemented Carbide material.
For best results, fine parameter adjustments may be required, depending on the Carbide material; milling shape and strategy; machine rigidity and spindle capability.

Note:

- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet /holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Recommend shallower drilling than flute length to promote good chip evacuation.
- Recommend using peck drilling cycle, but single-shot drilling may extend the tool life in some cases.
- Recommend air blow.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips/dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.
- Peck drilling is required depending on the hole quality & hole-edge chipping.
- We recommend to avoid operating the machine unattended when using large size tools with high MRR (Material Removal Rate) per hole.
  Rapid tool wear, sudden tool damage or breakage might occur depending on the processing environment.
- When milling some work pieces, heavier chips may be created.
  To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.

Size **M2～M8**

UDCT

MG　UDC　Shank Dia 0/-0.005

Material Applications（☆ Highly Recommended ◎ Recommended ○ Suggested）

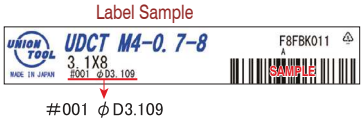
Work Material														
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～55HRC	HARDENED STEELS ～60HRC	HARDENED STEELS ～70HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE (NON-METALLIC) MATERIALS
											○			☆	◎ *

* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Features

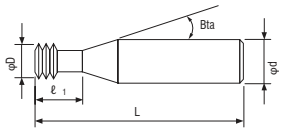
Thread Mills for Cemented Carbide and Hard Brittle (Non-Metallic) Materials.
Direct milling offers higher efficiency and precision comparing to EDM and grinding process.
Developed to give improved hardness and durability, the new Diamond coating also has outstanding adhesion to the tool.
UDC series End Mills and Drills are recommended to drill holes before threading.

Label Sample



#001 φD3.109

Measured diameter is printed on the label.



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 10 models

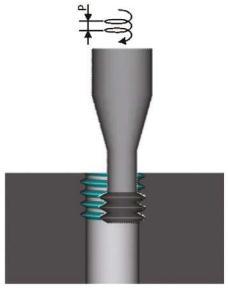
Unit（mm）

Model Number	Thread Diameter M	Pitch P	Tool Diameter ØD	Number of Flutes	Effective Length ℓ_1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Price ¥
UDCT M2-0.4-4	M2	0.4	1.5	2	4	16°	50	4	38,900
UDCT M2.5-0.45-5	M2.5	0.45	1.9	2	5	16°	50	4	38,900
UDCT M3-0.5-6	M3	0.5	2.4	2	6	16°	50	4	38,900
UDCT M4-0.7-8	M4	0.7	3.1	2	8	16°	50	4	38,900
UDCT M5-0.8-10	M5	0.8	3.9	2	10	16°	60	6	42,800
UDCT M5-0.8-15					15		60	6	42,800
UDCT M6-1-12	M6	1	4.6	2	12	16°	60	6	42,800
UDCT M6-1-18					18		60	6	42,800
UDCT M8-1.25-16	M8	1.25	5.9	2	16	16°	60	6	42,800
UDCT M8-1.25-24					24		60	6	42,800

UDCT Milling Conditions

WORK MATERIAL					CEMENTED CARBIDE		
Model Number	Thread Diameter M	Pitch P	Tool Diameter ØD	Effective Length ℓ_1	Recommended Diameter of Hole Before Threading (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)
M2-0.4-4	**M2**	0.4	1.5	4	Ø1.6	20,000	3
M2.5-0.45-5	**M2.5**	0.45	1.9	5	Ø2.1	20,000	3
M3-0.5-6	**M3**	0.5	2.4	6	Ø2.5	20,000	3
M4-0.7-8	**M4**	0.7	3.1	8	Ø3.3	10,050	30
M5-0.8-10	**M5**	0.8	3.9	10	Ø4.2	8,000	30
M5-0.8-15				15			
M6-1-12	**M6**	1	4.6	12	Ø5	6,800	30
M6-1-18				18			
M8-1.25-16	**M8**	1.25	5.9	16	Ø6.8	3,500	20
M8-1.25-24				24			

These milling parameters are based on VM-40 (CIS standard) and are for reference only.
Tool life may differ depending on the type of Cemented Carbide material.
For best results, fine parameter adjustments may be required, depending on the Carbide material; milling shape and strategy; machine rigidity and spindle capability.



Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Use a machine equipped with helical interpolating functions.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Decrease both spindle speed and feed rate proportionally.
- The feed rate is measured at the center of the tool.
- The radial cutting depth is recommended to cut all at once. Do not cut several times.
- Adjust turning radius amount to meet required internal thread precision.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Advisory for Safe Use of UNIMAX Tungsten Carbide End Mills

Correct application and operation is strongly advised to avoid clogging, abrasion, etc, that could cause serious accidents or injuries.
Ignition or sparks generated during milling could lead to fire or extreme damage to the work piece.
End Mills are made with very sharp cutting edges and must be handled with extra care.

* Never touch the cutting edge with your bare hands, as this could cause serious injury. Special caution is required when opening the package.
* Dropping the tool could cause breakage or flying debris, leading to serious injury.
* During milling, unexpected impact or shock on the tool could cause breakage or flying debris. Ensure to use protective items such as safety glasses and a face guard.
* For best results, fine parameter adjustment may be required, depending on the materials; milling shape and strategy; machine rigidity and spindle capability.
* Use a machine that has high rigidity and generates a low level of vibration.
* Do not use flammable cutting oils.

Advisory for regrinding UNIMAX Tungsten Carbide End Mills

* Never regrind the tool without wearing safety glasses and a face guard.

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